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THE PLANNED DEVELOPMENT OF HUMAN RESOURCES

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THE PLANNED DEVELOPMENT OF HUMAN RESOURCES

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B.2.1.

1. The purpose of this paper is to stress the importance which the planned development of human resources now has for developing countries, by providing them with rational criteria on which to base a policy for developing human resources that can be integrated in economic development planning. Recent developments in theory and practice have shown that planning methods can to a large extent be applied to these problems; other branches of social sciences (education, sociology) or even specialised branches of these sciences (employment, productivity) can also play their part in the rapid promotion of knowledge and possible lines of action in this field. It would be possible to take steps which would be both simple and inexpensive to complete the statistical picture. Concerted international action along specific lines of research having immediate priority would yield speedy and effective results.

2. Importance of human factors

It is well known that the economic development policies of all states have similar aims (per capita income growth) and are based on relatively similar techniques of economic forecasting, that is, of programming or planning. While their efficacy is generally acknowledged, it is a known fact that, since these techniques have been developed and applied in industrialised countries, particular difficulties are encountered in applying them in developing countries, arising mainly from the specific social problems of such countries. Hence, the importance of the contribution which can be made by social sciences to the awareness of these problems.

In an initial phase these various sciences attempted, each from its own approach, to describe and analyse the various characteristics of underdevelopment. It appears that a new phase has now been reached in which underdevelopment, considered as a widespread phenomenon, can be tackled on a basis of mutual co-operation between these various sciences. The unprecedented, world-wide extent of underdevelopment problems requires, moreover, this kind of collaboration between men of action and those engaged in research if national and international decisions relating to action for rapid development are to acquire a greater degree of rationalisation.

3. Education

One of the major objectives in the social field is the development of education - not only because the right to education is set forth in the International Declaration of Human Rights or because education is a prerequisite for all individual advancement but also because it is an essential condition for social, political and economic development. Education is the most powerful means of integrating a limited group into the national community, the modern state and the monetary economy. No progress in means of communication and information can bring about rational conduct on the part of citizens, producers and consumers as effectually as education. Large-scale regional programmes have been undertaken to provide education to all young persons within the next ten or twenty years. The magnitude of the means for carrying this out tends to generalise the manner in which educational plans are drawn up. Although the methods differ from one country to the next, in all cases they consist in specifying the necessary staff and credit means for providing education to the number of pupils envisaged for the period in question. These objectives, however, are established in relation to social objectives such as the providing of primary education to the whole population, the doubling of the number of pupils who are given secondary or higher education, and so forth; economic factors play a part only in that phase of financing when care is taken to ensure that the objectives pursued are compatible with the available financial resources, both as regards the initial outlay and the yearly operational costs. From this approach, however, the amounts devoted to education for social or political reasons proportionately reduce the resources available for infrastructure or productive investments. It is for this reason that endeavours are made at present to show that the costs of training men must be considered as a productive investment. Recent studies on economic growth have brought to light the existence of a "third factor", as important as labour and capital, which has to do with educational improvement, vocational training, management, educational environment, etc.

Investigations carried out in the United States have demonstrated the "return" on education by comparing the wage differentials of individuals with the direct or indirect costs of their education. But at the macro-economic level it should be possible to measure the social return on total educational expenditures, something which has not yet been possible to estimate.

4. Manpower training

Another basic problem is the shortage of trained manpower at all levels: workers, foremen, technicians and engineers as well as top and middle management. No longer are low wages considered to be a factor that encourages production and attracts foreign capital; on the contrary, it has become evident that the training of workers is a decisive condition for producing returns on investments and increasing productivity. A country's capacity for absorbing capital is probably limited mainly by the level of manpower training. Many examples in history point

to the relationship between this factor and economic growth.

Considerable efforts have been undertaken at the national and international levels to increase the means of training skilled labour. Many new technical training establishments, vocational training centres and technical co-operation courses have been set up. Moreover, surveys have been carried out with a view to assessing quantitative requirements in terms of workers, technicians and engineers. However, a difficult choice is presented between two possibilities: either fast training for turning out highly specialised workers or long-term instruction for training workers capable of performing a number of functions. This problem often arises in an acute form owing to the fact that these two types of training come under different ministries or, at the international level, under different organisations. Decisions are taken on a practical basis: in certain countries vocational training centres are given the objective of training the skilled workers whom technical training institutes are unable to admit owing to lack of space; at times one type of training is systematically developed to the detriment of the other. In order to overcome rivalry of this sort it would be necessary to place this teaching problem in the broader context of the economy's needs in terms of labour and the kinds of skills required.

Another difficulty as regards the training of skilled labour has to do with recruitment. In many countries the prestige involved in a general education, which leads more readily to higher education and administrative or managerial posts in the government, politics or the private sector, turns the most gifted youth away from technical and vocational training and, at times, even from scientific studies. This problem can only be solved within the framework of a national policy of education which establishes the relationship between the various grades and branches of education in terms of the needs involved in development. To give priority to the establishment of technical or vocational training institutes or to assess requirements in terms of workers or engineers can lead only to a partial and insufficient approach. The example of certain countries shows that the output of personnel provided by technical establishments whose cost is extremely high may be insufficient in quality and quantity at the same time that many graduates of secondary and higher schools are unemployed. Moreover, a country's development cannot be based solely on the growth of the manufacturing industries any more than the aim of education can be limited to training industrial workers. The satisfactory operation of government machinery and political institutions, the development of the infrastructure and the commercial network, the improvement of agriculture are complementary aspects and all depend to a large extent on the training of middle and senior supervisory staff. It is therefore impossible to separate a field of education or the educational system from social and economic aspects.

5. Full employment

A third main problem concerns employment. A shortage of skilled labour causes considerable unemployment in towns and,

although more difficult to assess, even more widespread under-employment in the country. This situation becomes more serious each year due to the growth in the population. The extent of this problem becomes clear when the probable increase in the labour force is compared to the number of new jobs provided for in economic plans. In industrial countries the goal of full employment can be included in economic policies, for example by bringing direct or indirect pressure to bear on the volume of investments. In developing countries, however, the volume of investments is limited to a much greater extent. On estimating the amount of investments required for creating new jobs in industry or agriculture, it appears impossible to absorb existing unemployment and under-employment or even to check their growth. Drift from the land takes place at a fast pace owing to social and economic pressures and causes the urban population to grow at a faster rate than labour demand in industry or services; nevertheless the number of rural workers continues to increase, bringing about lower production per head in agriculture.

The "shadow price" method which takes account of the over-estimate of wage rates and the shortage of capital, or the method which gives preference to expenditures in local currency, are useful; however, the point is to provide a corrective to the economic estimate rather than include therein an objective of full employment.

With respect to the "timely costs" method, this makes it possible only to compare social costs, such as those of education, with productive investments which it is necessary to forego.

On the other hand, the experience of community development and human resources designed to mobilise under-employed labour for jobs requiring limited capital investment is based on social objectives but eludes economic estimates and is thus prevented from being situated in a rational manner within development planning.

6. The relationship between the three problems

The urgency of these three series of problems is such that theory has been outdistanced by practice. The drawing up of a coherent development policy nevertheless requires a graded scale of priorities and, consequently, a general method which allows the various objectives to be compared and integrated. To reserve for economic planning the privelege of a scientific method while leaving social objectives to arbitrary decisions would constitute a source of waste and a dangerous duality of purposes. The technical and political fields should not be mutually exclusive but should complement one another.

Thanks to the research undertaken in the three fields mentioned above, it is already possible to foresee the feasibility of utilising planning techniques, if not of developing a general

theory on the development of human resources (which should include, in particular, health, factors of micro- and macro-economic organisation, research, etc.).

The development and specialisation of each branch of the social sciences have tended to create isolated fields. In each of these fields, however, new and converging lines of research are being undertaken. To develop individual aptitudes and encourage social change no longer appear as the sole object of education; it also aims now at preparing future workers to play an active part in economic development. In modern methods of training manpower increasing importance is given to general education and to the development of intellectual faculties of adjustment and creation; endeavours are made to guide the mobilisation of labour along lines of productive employment which can be integrated in development planning.

The steps which enable these three social objectives to be integrated in economic development planning are described below.

7. The relationship between educational planning and economic planning can be considered under three main aspects:

(a) The total financing of an educational plan must be compatible with the financial resources of the country. In most national and regional plans the educational aims are established before estimating the cost. Increased attendance and improved quality are simultaneously aimed at, by applying desirable standards whose cost is far above present costs; in the case of comprehensive plans which are not limited to a partial sector of education (such as school-building or primary education, etc.), the extent of the sums required is such that they are always reduced during the implementation of the plan, thereby entailing a constant and improvised revision of the aims - something which is incompatible with the notion of planning and which destroys the coherence of the plan's estimates and the graded scale of priorities. These shortcomings in method are less serious in industrial countries since they are in a position to achieve the objectives desired by allocating, should they so decide, the necessary funds for this purpose without harming economic growth.

(b) The priorities of the educational plan must be harmonised with those of the economic plan. The basic choices made in respect of the development plan involve a reorientation of the educational system, affecting both the various grades and branches of education and their nature.

The objectives of industrial development can only be achieved if labour has received the necessary training in sufficient time to make proper use of the capital equipment. Means should be provided in agricultural development programmes to specify requirements in terms of rural welfare workers, assistant instructors and agricultural technicians. The regions where priority is to be given to efforts towards economic development are those where priority will also be given to the

development of basic school facilities, etc.

(c) The educational plan must be based on a forecast of labour requirements, which can be ascertained from the aims of the educational plan. This forecast must be made on a long-term basis in view of the time required for training; moreover, it must be capable of expression in terms of the educational objectives.

From this point of view, education may be regarded as an investment or rather, to be more precise, as an infrastructure expenditure for which it is possible to determine the cost and whose figure is fixed not only in relation to the potential of the economy but also to production targets, labour requirements and, to a certain extent, targets in respect of full employment.

Data which can be measured will now be indicated, with a view to defining a common method for dealing with these various aspects from the standpoint of planning.

8. Financing of education

The limits with respect to the financing of an educational plan should be established on drawing up the plan rather than during the final phase. The present level of total educational expenditure should also be established (both public and private expenditure, the latter admitting of estimates, as well as training expenses borne by other ministries, provinces and muncipalities). This figure can then be compared to the gross national product, to the total net investments and to the total public expenditure for the same year; this, in turn, makes it possible to compare these figures to those of other countries. For projections account is taken of prospects for increases in the gross national product, the public expenditure and the investment which have been assumed in making the economic plan. It is then possible to make an estimate envisaging a low rate of growth (identical to that of the gross national product or public expenditure) and another envisaging a high rate of growth (greater increase in educational expenditure, an annual increase of 10 per cent. representing the maximum in an average period). The figures for investment and increased operational expenditure (the latter being linked with the former by a more or less constant coefficient) must fall within these extreme limits according to the degree of priority allocated by the government to education; it will thus be possible from the outset to select alternatives and to set stages of progress based on a realistic viewpoint and not on an unattainable ideal.

It would also be desirable to measure the development of educational investments during recent years; such an estimate in constant prices presupposes the establishment of a deflation index peculiar to education.

The entire educational system at present can be represented by a pyramidal diagram showing the age groups from five to 25 years of age and the enrolled pupils according to the grade and branch of education. The educational system at the end of the

period covered by the plan can be represented in the same way, together with the relationship between the grades and branches of education corresponding to the objectives of the economic plan. A simple comparison of the two charts will show what discrepancies must be corrected, what sectors must be developed first and what educational reforms must be introduced.

9. Estimate of labour requirements

Difficult problems arise in estimating labour requirements, especially with respect to adopting a method of labour classification that can be linked with long-term economic estimates and educational plans. Employment statistics, even when drawn up in accordance with international standards (I.S.C.O.), are designed to illustrate the nature of trades (some 1,300), thus making it possible not only to adjust supply to demand but also to make short-term estimates. However, this method is both too complicated and too accurate to be practicable for long-term estimating purposes.

On the basis of the experience of a number of countries (France, Italy, Nigeria, etc.), it is proposed that a method of classification be used based on the individual level of education (measured in terms of the number of years spent studying) and not on the type of trade. This implies that there is some kind of balance between occupational skill or qualifications and the actual degree of education received, disregarding the distinction between general and specialised education as well as between education as an item of consumption and as an investment. Research conducted in various countries has revealed that there are different levels of training which correspond to varying degrees of education, though the scale of reckoning differs from one country to the next.

The principal stages in preparing such an estimate are as follows:

(a) Evaluation of the existing active population expressed by t_o, including the unemployed and under-employed. Distinctions can be made in this evaluation as to age groups and sexes.

(b) Distribution of the active population expressed by t_o according to the economic sectors and, within each sector, according to the level of training.

The fields of activity selected will be the same as those covered in the national accounts. Failing such accounts, a classification divided into a few principal fields such as agriculture, mining, industry, building, transport, public administration, etc., will suffice. Whenever possible it will be advantageous to distinguish between traditional and modern sub-sectors, since training requirements may often differ between them.

At each level of training workers possessing the required degree of theoretical education are to be distinguished from those holding posts at that level without the required degree of education.

According to available statistics there are four to six different levels of training.

(c) Evaluation, in the same way, of the available active population expressed by t_n, taking into account the natural shift in the population and the balance of emigration and immigration. The figure thus obtained is corrected in relation to structural or contingency factors such as the compulsory or voluntary extension of the period of education, the size of the female working population, average age of retirement, etc.

(d) Use of economic projections as concerns the output of the various sectors in added value and the increase in the productivity of these sectors.

(e) the rate of increase in productivity will determine the total volume of labour required in each sector, according to the following formula:

$$L_n = L_o \frac{O}{P}$$

in which L_n = the number of workers in the sector in t_n

L_o = " " " " " " " " t_o

O = the index of variation in output from t_o to t_n

P " " " " " " productivity from t_o to t_n

(f) The main problem consists in estimating the trend in the distribution of skills in each sector. Various methods may be used for this:

- Extrapolation of past tendencies. This method is hardly satisfactory, not only because productivity may grow at a very rapid pace in underdeveloped countries but also, in view of the existence of considerable deficits, because the situation serving as a point of departure is anything but ideal. On the other hand, the departure of foreign technicians can produce a temporary drop in present productivity.

- International comparison. Country A wishes to attain in t_n the level of country B in t_o. Let us assume that the distribution of skills in A in t_n is the same as that of B in t_o. This method is also problematical in that available statistics, as a rule, do not show clear-cut tendencies, owing no doubt to differences in definitions, although another reason is that certain modern fields of activity require from the outset an equal distribution of skills irrespective of the average level of development of the economy.

- Another method is direct investigation by teams composed of economists, teachers, employers and workers. First the type of investment (high or low capital intensiveness) in each sector is determined and then the various levels of skills required.

In underdeveloped countries where capital is scarce, the optimum relationship between output and capital must be taken as the principal criterion to be applied. On a short-term basis this may mean that fewer jobs are created, but on a medium or long-term basis the rise in production brings about the highest possible level of employment.

Obviously the distribution of skills is not identical in all sectors. Where production techniques already exist, this distribution may be determined by surveys carried out among firms; where new techniques are to be introduced, it will be based on average undertakings in the industrialised country where such techniques originate.

All these methods should be simultaneously employed, so that they may serve as a basis for reasoned hypotheses which take all the results into account, so long as there are no long-term economic forecasting techniques which enable a more exact estimate to be made of the trend of productivity over extended periods.

10. Expressing labour requirements in terms of the educational plan.

Thus, we have two series of pyramids representing the entire active population in t_o and t_n, distributed according to levels of training (the former representing the present situation and the latter the situation aimed at) and according to fields of activity. The transition from one stage to the other raises a problem that must be solved by the educational plan in terms of continuous flow, i.e., of the yearly output of graduates. Various sub-groups may be distinguished at each level. The annual number of pupils to be taught at the six different levels can then be determined, taking into account the time required to modify the annual output of graduates.

Estimates in respect of specialised types of education (engineers, doctors, technicians; technical, agricultural and vocational training) will be made for the same number of sub-groups as specified in the preceding phase. Also, the need to replace that fraction of the labour force which ceases to be active owing to retirement or death must be taken into account. This annual rate of replacement (which varies more or less inversely with the average duration of active life) may vary slightly according to the levels of education. The gross increase of labour during the period is thus obtained, which indicates the number of pupils to be taught at the various levels.

In sectorial estimates account must also be taken of a "shift rate" applying to trained specialists who transfer to other employment, such as teachers who enter the government, engineers holding administrative posts, etc. Such shifts are cancelled out at the national level unless international movements are taken into consideration (importation and exportation of labour).

In order to express the output of graduates in terms of pupils to be taught at each level of studies, parameters must be introduced which take account of two qualitative factors in eduation, namely:

(a) the number of pupils who do not complete their courses, which can be expressed by a "single rate" for each full course of studies: the relation between the number of pupils enrolled in the first year of studies and the number who finish the total course or, if account is taken of examination results, those who finish with satisfactory marks;

(b) the number of pupils who repeat courses, which can be expressed by a single parameter for each course of studies showing the average time that training actually lasts instead of the prescribed duration: for example, seven years for completing six grades of studies.

The same methods can be applied to the estimates by sub-groups. Account must be taken of those persons, mainly women, who have received training but who will not become part of the active population. Rates of activity can be calculated with respect to these sub-groups.

The number of teachers required can then be estimated, by applying the ratio between teachers and pupils to the total number of persons to be taught at each level or in each sub-group. The impossibility of developing the educational system at a sufficiently rapid pace to meet the labour supply expected in t_n may emerge from such a comparison. If the total active population in t_n (the sum of the six levels) is determined mainly by demographic growth, labour supply at a given level may increase much faster; this can take place only through a more proportional increase in the annual output of graduates, an increase which varies, besides, according to the duration of the period covered by the plan. Owing to the fact that training periods cannot be reduced, the effect of this speedy growth is to impose limits on educational efforts and may lead to the need for revision of the original objectives or their extension over a greater period of time. In any case, however, most of these parameters admit of flexibility and can be considered as variables.

Thus, the number of pupils who repeat or fail to finish courses and the number who fail examinations can be reduced by improving the efficiency of the educational system. This, in turn, can be accomplished by ensuring that teachers are better qualified, by reducing the number of pupils per class, by improving school equipment and teaching techniques - all of which entails an increase in the average cost per pupil. Such an increase is justified so long as it reduces the cost of the trained pupil. This balance between the quantity and quality of education can be expressed in optimum terms if the extent of each of the causes of insufficiency can be assessed as well as the cost and effectiveness of the means for remedying them.

At the same time incentives can be envisaged for lengthening the average length of active life, raising rates of activity, lowering "shift" rates, encouraging advancement of adult workers, etc.

A problem concerning the allocation of human resources arises when the attempt is made to attain the maximum development of education at the same time as maximum economic development. Both types are limited by the pace at which new workers enter active life. An optimum balance between these two needs can be found by establishing a model of two fields - the teaching field and the non-teaching field. The temporary need for foreign teachers or technicians, or both, can also be estimated.

11. The problem of full employment

The problem of full employment can be approached from the viewpoint of training. Mobilisation of under-employed labour can be utilised for productive occupations if a sufficient source of supervisory staff for that manpower is available. If there is insufficient supervisory staff, uneducated and unskilled workers can only be employed in elementary jobs such as road work and navvying. But a sufficient number of technicians, foremen, skilled and semi-skilled workers can serve as supervisory staff for those same workers and thus enable them to perform more complex and productive work capable of furthering the objectives of the economic plan. Techniques requiring little outlay and considerable manpower could be studied from the standpoint of supervisory staff requirements, the training of these supervisors thus serving to multiply the number of jobs. Training ten skilled workers would enable a much greater number of unskilled workers to be employed in productive work.

In agriculture, development programmes are held up more by the lack of supervisors than by technical factors or limited resources. Standards can be worked out which specify the number of agricultural technicians, assistant instructors and rural welfare workers required to supervise farming units.

In this way the productivity of the traditional sector can be raised to the point where it becomes possible to integrate the work achieved by these labour intensive methods in the development plan.

Conclusion

We have seen how the three objectives of education, manpower training and full employment, in utilising similar techniques, can be considered as interdependent and linked with the economic development plan. Education, in being regarded as the development of human resources, can be considered from the standpoint of labour supply, in that young persons on completing their training appear on the employment market, and from the standpoint of labour demand, in the sense that the quantitative and qualitative labour requirements determined

by the economy must be met by the educational system. The problem to be solved through programming or planning consists in finding a balance between this supply and demand while at the same time ensuring full employment.

Considered as supply, education first presents itself to individuals as a desire for acquiring instruction, which springs not only from the concern to prepare oneself for working life but also from social factors (the prestige involved in certain types of education or certain trades) and cultural ones (the satisfying of non-monetary needs). This aspect of education, as an item of consumption, acquires greater importance as the standard of living increases.

Secondly, education must meet labour demand. This cannot be analysed in the same way as the demand for material goods, since many factors are involved: the labour requirements of an economy at a given level and time, which are revealed by shortages and pressures on the labour market; the future requirements of economic development which are not yet felt; the extent to which demand depends on supply in the sense that trained men are able, in certain conditions, to create their own openings when highly qualified cadres raise the technical level of the economy or when skilled labour attracts foreign capital and opens up possibilities for productive investments; the development of education helps to increase the ability to absorb capital.

The attempt here has been made to show how the scope and nature of the minimum effort required in the field of education to achieve a given rate of economic growth can be assessed. The use of these estimating techniques obviously raises other difficult problems that have not been dealt with here, such as the development of the technical level and productivity over an extended period of time, the confusion between aspects of labour supply and demand, etc. But an even more difficult stage must be passed through if education is to be dealt with not only in terms of minimum but of optimum requirements. This presupposes that the social return on education can be gauged in the same manner that the return on investment is measured with the help of the capital coefficient.

It would then be possible to estimate the amount of investment in personnel training required to achieve a given objective of growth in optimum (and no longer minimal) conditions. Research carried out on economic growth has caused the "third factor" to appear as a residue including improvement in the level of education as well as in that of health, technical advance, research, management, etc. It is now possible to assess quantitatively the educational stock of the active population according to the public and private expenditures[1] required for training. In this way it is possible to isolate one of the

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[1]Provided that only real costs of education are taken into account and not forfeiture of earnings.

components of the
"third factor", to measure the return on training and introduce it in the economic estimate.

In each case, it will now be necessary to gather the statistical data essential for educational planning and estimates of labour requirements. Such data should be standardised at the international level so that comparisons may be made between countries. Two important advances can be made in this field.

The first would be to specify, in the total figures for each class, the number of pupils repeating courses, thus making it possible to introduce qualitative factors into educational planning. The second would consist in completing census taking and industrial surveys by including a question as to the number of years spent in study or better still, in accordance with the international recommendation of UNESCO, requiring an indication of the type of studies undertaken during the previous year; this would make it possible to classify the working population according to levels of training and to assess the educational stock of the active population.

Notable strides have been made in recent years to improve the statistical data required for drawing up and improving national accounts in many countries. A similar effort should now be undertaken by developing countries, research institutes and international organisations to collect the data required for social accounting, which is as important as that concerning material goods. This would constitute an important step towards a broader concept of development planning.

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C O R R I G E N D U M

Delete : "par l'Institut d'étude du Développement économique et social, Université de Paris"

and insert : "By Michel DEBEAUVAIS, de l'Institut d'étude du Developpement économique et social, Université de Paris"

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C O R R I G E N D U M

Agenda Item should read : B.

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**КОНФЕРЕНЦИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ
ПО ВОПРОСУ О ПРИМЕНЕНИИ НАУЧНЫХ И ТЕХНИЧЕСКИХ ЗНАНИЙ
ДЛЯ УДОВЛЕТВОРЕНИЯ ПОТРЕБНОСТЕЙ МЕНЕЕ РАЗВИТЫХ РАЙОНОВ**

ПУНКТ ПОВЕСТКИ ДНЯ: B.1

СССР

ОРГАНИЗАЦИЯ СТАТИСТИКИ НАСЕЛЕНИЯ И ЕЕ ЗНАЧЕНИЕ ДЛЯ ПЛАНИРОВАНИЯ РАЗВИТИЯ ЭКОНОМИКИ И КУЛЬТУРЫ

Составил П. Г. ПОДЪЯЧИХ,
Центральное статистическое управление.

Документы, составленные для Конференции Организации Объединенных Наций по вопросу о применении научных и технических знаний для удовлетворения потребностей менее развитых районов, служат в качестве рабочих документов для этой Конференции. Они опубликованы в том виде, в каком были представлены их составителями, и их содержимое и выраженные в них мнения принадлежат их составителям (см. примечания на оборотной стороне).

ПРИМЕЧАНИЯ

1. Документы, включенные в число материалов, принятых для обсуждения на общих сессиях, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

2. Документы, включенные в число материалов, принятых для обсуждения на специализированных сессиях, будут в распоряжении делегатов Конференции только на одном из этих официальных языков.

3. Резюме всех документов в том виде, в каком они были представлены их составителями, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

4. До открытия Конференции документы и резюме не будут выпущены для общего распространения. Они будут опубликованы заблаговременно только в ограниченном числе экземпляров и исключительно для правительственных делегаций и других правомочных участников. Последующие опубликование и рассылка трудов Конференции будут обеспечены в соответствии с практикой Организации Объединенных Наций, как это установлено ее Издательским комитетом.

ОРГАНИЗАЦИЯ СТАТИСТИКИ НАСЕЛЕНИЯ И ЕЕ ЗНАЧЕНИЕ ДЛЯ ПЛАНИРОВАНИЯ РАЗВИТИЯ ЭКОНОМИКИ И КУЛЬТУРЫ

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I. Население страны – самый ценный ее капитал. В процессе развития экономики человек выступает как главная производительная сила, приводящая в действие средства производства и умножающая материальное богатство страны. При этом целью непрерывного расширения общественного производства с СССР является наиболее полное удовлетворение постоянно растущих материальных и культурных потребностей самого творца богатства – народа; девизом общества является: Все во имя человека, для блага человека".

В некоторых странах нередко пропагандируются мальтузианские "теории" об опережающем росте численности населения в сравнении с ростом производства средств потребления, хотя история развития человеческого общества давно неопровержимо показала, лживый характер этих теорий. Правительства некоторых стран, будучи в плену таких лжетеорий, ставят вопрос о широкой разработке мероприятий по приведению уровня рождаемости и численности населения в соответствие с уровнем экономического развития, вместо того, чтобы ставить вопрос наоборот, т.е.об использовании всех достижений науки и техники для такого развития экономики каждого государства, которое бы соответствовало росту его населения. Неотъемлемой чертой развития хозяйства СССР, в том числе и экономики национальных республик, бывших в прошлом отсталыми колониями царской России, на всех исторических этапах являлось обеспечение такого расширения общественного производства, которое бы полностью соответствовало росту численности населения. История развития советских республик – это история непрерывного опережающего роста экономики в сравнении с ростом численности населения. Наглядным показателем этого является то, что рост национального дохода в СССР за период с 1913 г.по 1961 г.в 18 раз превысил рост численности населения.

В Советском Союзе развитие хозяйственной и культурной жизни, повышение материального благосостояния населения определяется и направляется народнохозяйственными планами. Плановое ведение экономики, контроль за выполнением установленных планов осуществляется посредством создания и совершенствования единого народнохозяйственного учета и статистики. В системе статистических показателей, отражающих состояние и развитие хозяйственной, культурной и политической жизни общества, первое место занимают показатели о численности и составе населения. Подробные и точные данные о численности и составе населения являются основой народнохозяйственного планирования, т.к.при разработке планов развития общественного производства плановые органы исходят из потребностей членов

общества и из наличных трудовых ресурсов для выполнения планов.

Источниками данных о населении являются переписи населения и статистика естественного движения и миграции населения. Переписи дают наиболее точные данные о численности, размещении и составе населения по полу, возрасту, семейному положению, национальности, родному языку, учебе, уровню образования, занятиям, отраслям народного хозяйства, социальным группам и т.д. В межпереписные периоды расчеты численности и важнейших показателей состава населения / по полу, возрасту, социальным группам/ проводятся на основе данных статистики естественного движения и миграции населения. С развитием экономики и культуры и расширением тем и показателей народнохозяйственного плана потребность в данных о составе населения непрерывно возрастает.

2. Слабому экономическому развитию царской России соответствовала слабая статистическая служба. Дореволюционная /до 1917 года/ статистика населения основывалась на материалах единственной переписи населения, проведенной в 1897 г., на данных церковной регистрации рождений, смертей и браков при совершении обрядов крещения, отпевания умерших и венчания, а также на данных переселенческой статистики.

Сравнительно полно регистрация рождений, смертей и браков велась тогда только в 50 губерниях Европейской части России, где преобладало население православного вероисповедания; данные регистрации на Кавказе, в Сибири и особенно в Казахстане и Средней Азии / в теперешних Казахской, Узбекской, Таджикской, Киргизской и Туркменской союзных республиках/ были крайне неполными в результате обычаев преобладавшего здесь населения мусульманского вероисповедания и наличия кочевого населения. Переселенческая статистика не охватывала всей миграции потому, что основывалась на регистрации переселенцев лишь в главных пунктах путей их следования. Между тем миграция населения на восток в результате аграрного перенаселения имела широкие размеры. Значительным было и "обратное переселение" в результате того, что перенаселенцам органы власти не оказывали помощи в хозяйственном устройстве. Таким образом по Европейской части дореволюционной России статистика населения требовала значительного улучшения, а в Казахстане и Средней Азии она по существу должна была создаваться.

3. Учитывая, что без полных и точных данных о численности, составе и размещении населения невозможно обеспечить успешную работу органов государственного и хозяйственного управления и планирование развития хозяйства и культуры, советское государство с первых же дней своей деятельности приняло меры к серьезному улучшению статистики населения в стране. Менее, чем через 2 месяца после Октябрьской революции / 18 декабря 1917 г/ был издан декрет о введении специальных книг для записи актов гражданского состояния - рождений, смертей, браков, а еще через месяц -/23 января 1918 г./ был издан декрет о передаче функций регистрации этих актов из ведения церкви в ведение гражданских органов. Для получения подробных и точных данных о численности и составе населения уже в 1920 г. была проведена перепись населения, хотя тогда еще не закончилась гражданская война и интервенция капиталистических государств против молодой советской республики. Руководитель государства В.И.Ленин, говоря о значении переписи, заявил, что ее данными будет положена основа советского строительства. В связи с военными действиями перепись охватила немногим более 70% территории страны.

Проведение переписи и мероприятия по улучшению дела регист-

рации актов гражданского состояния заложили фундамент для серьезного улучшения статистики населения, однако, процесс создания хорошо организованной статистики естественного движения и миграции населения, несмотря на серьезное внимание к этому вопросу, потребовал длительного времени. Передача дела регистрации актов гражданского состояния из ведения церкви в ведение гражданских властей затянулась на несколько лет в связи с тем, что органы власти не имели опыта этой работы и не сразу были найдены правильные организационные формы аппарата регистрации. В сельских местностях эта работа была поручена существовавшему аппарату органов самоуправления, а в городах пришлось создать при органах власти отделы записи актов гражданского состояния /ЗАГС/. Организация этих отделов была закончена к 1923 г. Лишь в республиках Средней Азии и некоторых окраинных районах, где из-за низкой грамотности населения трудно было подобрать работников, отделы в некоторых городах были созданы в более поздние сроки. Вся территория страны была охвачена регистрацией примерно к 1926 г. В настоящее время регистрацию актов в сельских местностях ведут сельские Советы, которых насчитывается 40,6 тыс. / в среднем на сельский Совет приходится около 2,7 тыс.жителей/, а в городских поселениях - отделы при местных исполкомах /5 тыс.отделов, в среднем на отдел приходится около 23 тыс.жителей/.

Полнота регистрации, особенно регистрации умерших в отдельных районах и городах долгие годы оставляла желать много лучшего. Причиной этого была как неопытность работников регистрации, так и и то, что население не привыкло еще своевременно регистрировать рождения и смерти. Органам статистики пришлось длительный период упорно воспитывать работников регистрации и проводить разъяснительную работу среди населения путем проведения собраний, освещения важности вопросов своевременной и полной регистрации в печати, выпуска плакатов и т.д. Особенно длительно разъяснительная работа велась в районах расселения мусульманского населения, где национальные традиции препятствовали своевременной регистрации, особенно умерших.

Наряду с разъяснительной работой, органы статистики систематически, как правило, раз в год проводят выборочные контрольные проверки полноты и правильности регистрации органами ЗАГС рождений, смертей, браков, разводов. Результаты этих проверок использовались раньше для внесения поправок в показатели естественного движения населения национальных республик. В настоящее время, когда регистрация стала полной и правильной, проверки проводятся лишь с целью дальнейшего повышения уровня работы.

Для статистической разработки результатов записи актов гражданского состояния в 1919 г. была введена специальная статистическая карточка, в которой на каждого родившегося, умершего, вступившего в брак и разведенного записывался минимум данных; на основе их составлялись сводные данные по территории. В 1926 г.карточка была упразднена, а акты о рождении, смерти, браке и т.п.стали записываться в 2 экз., из которых один хранился в органах ЗАГС, а второй передавался органам статистики для получения данных о естественном движении населения.

4. Программа регистрации с течением времени изменилась. В настоящее время она имеет следующее содержание:

а/ В акте о рождении записывается фамилия, имя, отчество родившегося, пол, время и место рождения, сколько родилось детей / один, двойня, тройня/, живорожденный или мертворожденный, сколько всего детей рождалось у матери, из них осталось в живых; об

отце и матери записываются фамилия, имя, отчество, национальность, возраст, род занятий, место работы, место постоянного жительства. Разработка ответов на эти вопросы дает возможность иметь данные о рождаемости в различных группах населения по отдельным районам, городам и областям.

б/ В акте о смерти записывается фамилия, имя, отчество, пол, возраст умершего / для детей моложе I года указывается возраст с точностью до дней, для детей умерших до 5 лет указывается время их рождения/, национальность, дата смерти, адрес места постоянного жительства, причина смерти.

в/ В акте о браке в отношении каждого вступающего в брак записывается фамилия после брака, фамилия до брака, имя, отчество, национальность, время рождения, место рождения, семейное положение / в браке не состоял, вдов, разведен/, в каком по счету брак вступает, место постоянного жительства.

г/ В акте о расторжении брака указывается фамилия после расторжения брака, фамилия брачная, имя, отчество, возраст, национальность, в каком по счету регистрируемом браке состояли, когда был заключен расторгаемый брак, место постоянного жительства.

5. О естественном движении населения составляется следующая отчетность:

а/ Районные и городские отделы ЗАГС составляют "Ежемесячную ведомость регистрации актов гражданского состояния" и представляют ее районному инспектору государственной статистики; инспектор после проверки и выписки необходимых для своей работы данных пересылает ведомость в статистическое управление области или республики / если республика не имеет областного деления/. Статистические управления областей и республик на основе этих ведомостей составляют итоговую сводку о числе зарегистрированных родившихся, умерших, браков и разводов; ЦСУ союзных республик сводку представляет в ЦСУ СССР. На основе этих данных имеется возможность ежемесячно знать об уровне рождаемости и смертности, числе вступивших в брак и расторгнувших брак в стране в целом, отдельных республиках, областях, районах, городах.

б/ Для систематического наблюдения за изменениями числа умерших от отдельных причин, на основании вторых экземпляров актов о смерти статистическими управлениями областей и республик ежемесячно составляется отчет о числе умерших по основным причинам смерти с выделением умерших детей в возрасте до I года. В этих отчетах указывается и число родившихся.

в/ Подробные данные о естественном движении населения получаются на основе разработки вторых экземпляров актов гражданского состояния раз в год. При этом получаются следующие сведения: общие итоги естественного движения населения за год и по месяцам; о родившихся по возрасту и общественной группе родителей; о родившихся по возрасту и национальности матери; о родившихся по порядку их рождения и возрасту матери; о родившихся у многодетных матерей по общественной группе матери / с выделением работающих матерей/; о родившихся и умерших в данном году по национальности; об умерших по возрасту и полу; об умерших в возрасте до I года по полу, числу прожитых дней и месяцев, календарным месяцам смерти и рождения и отдельным причинам смерти; об умерших в возрасте до 5 лет по поколениям; об умерших по полу, возрасту и причинам смерти; о браках по возрасту вступивших в брак и о разводах по возрасту разводящихся и продолжительности расторгнутых браков. Перечисленные показатели с достаточной подробностью характеризуют основ-

ные вопросы воспроизводства населения в СССР. В отдельные годы показатели годовой разработки расширяются.

6. Наряду с созданием статистики естественного движения населения, организовывалась статистика миграции населения.

В первые годы советской власти в связи с аграрным перенаселением, оставшимся от капитализма, сохранилась старая система стихийного сельскохозяйственного переселения. Плановое развитие экономики страны, рациональное освоение богатств восточных районов и национальных республик способствовало увеличению передвижения населения, особенно с запада на восток, и переселение все более и более стало осуществляться в организованном порядке с соблюдением принципа добровольности. Для руководства делом переселения в 1925 г. был создан Всесоюзный переселенческий Комитет при ЦИК СССР. В первый период работы этого Комитета осуществлялось в основном переселение сельского населения из густонаселенных районов в сельские местности малонаселенных районов. В период предвоенных пятилеток /1929-1941 гг/, по мере реконструкции народного хозяйства и развития индустрии, переселенческие органы стали обеспечивать потребности промышленности, строительства, транспорта и других отраслей в рабочей силе. Переселение сельского населения из села в город приняло широкие размеры. В этих условиях все острее и острее вставал вопрос о создании статистики миграции населения. Прежде всего была значительно улучшена переселенческая статистика, регистрировавшая переселенцев на путях их следования. Число пунктов, где проходила регистрация, было увеличено. По мере развития планового переселения, вместо этой регистрации, была введена отчетность райисполкомов об отправке переселенцев и отчетность колхозов о прибытии переселенцев и их трудоустройстве. Учет прибывших в города и выбывших из них был в ряде мест введен еще в 1923 г. В 1932 г., когда начался бурный рост численности населения городов за счет миграции в связи с интенсивным развитием промышленности, было принято постановление о ведении домовых книг домоуправлениями и хозяевами домов и обязательной регистрации в них прибывающего населения и выписке выбывающих. При этом составляются адресные листки, имеющие отрывные талоны с данными, необходимыми для статистической разработки сведений о каждом прибывающем в городские поселения и выбывающем из них. В последние годы учет прибывающих и убывающих организован и в сельских местностях. Таким образом, сейчас и по городу и по селу основным источником данных для статистической миграции являются отрывные талоны адресных листков на прибывших и выбывших, составляемые на лиц в возрасте 16 лет и более.

Содержание адресного листка и отрывного талона на прибывшего следующее: фамилия, имя, отчество, дата рождения, место рождения, пол, национальность, откуда прибыл, цель прибытия / на работу, учебу, в отпуск, лечение и т.п./ и на какой срок, место прописки, место работы, занятие, сведения о прибывших детях до 16 лет. Аналогичные вопросы содержатся в отрывных талонах на выбывших.

Разработка ответов на эти вопросы дает возможность получить статистические данные по стране и отдельным республикам и областям: о численности прибывших из других мест / с указанием из каких именно/, выбывших в другие места, т.е.о миграционных потоках, о механическом приросте, о половом, возрастном и социальном составе передвигающегося населения, о причинах передвижения и сезонности его. Краткие данные о миграции переселения подсчитываются ежеквартально, подробные - в годовых разработках.

В целях обеспечения точности данных о передвигающемся населении органы статистики систематически / не реже раза в год/ проводят контрольные проверки полноты прописки и выписки по выборочному кругу домовладений в городских поселениях и населенных пунктов в сельских местностях.

7. Наряду с регистрацией естественного движения и миграции населения, в СССР ведется текущий учет населения. В городских поселениях домоуправления и домохозяева ведут, как уже было сказано, домовые книги, содержащие поквартирные записи жильцов дома, а в сельской местности сельские Советы ведут книги похозяйственного учета, в которых по каждому хозяйству имеются записи о каждом члене семьи. В эти записи периодически вносятся изменения: исключаются умершие и выбывшие и вписываются родившиеся и прибывшие. Похозяйственные книги были введены в 1935-1938 гг.

Записи в домовых книгах городских поселений содержат фамилию, имя, отчество, дату рождения, место рождения, место работы и занятие. Записи в хозяйственных книгах сельских местностей содержат следующие основные сведения: фамилия, имя, отчество, пол, год и месяц рождения, место работы, в качестве кого и с какого времени работает, где учится и в каком классе или на каком курсе.

Записи в домовых или хозяйственных книгах используются не только органами местной администрации в текущей работе, но и для получения в необходимых случаях данных о составе населения, прежде всего по полу, возрасту и общественным группам. Эти данные, наряду с показателями естественного движения и миграции населения, используются для расчетов численности и состава населения в межпереписные периоды. Кроме того в этих расчётах используются данные о возрастном составе населения 18 лет и старше, получаемые на основе списков избирателей.

На основе этих источников ЦСУ рассчитало и опубликовало численность населения СССР на апрель 1956 г.в размере 200,2 млн.человек; расчёт на январь 1959 г.дал численность в 208 млн.человек. Переписью на 15 января 1959 г.учтено в СССР 208,8 мл.человек. Это небольшое отклонение первоначальных расчётов от уточненной численности свидетельствует о надежности указанных источников для перспективных расчётов.

8. В связи с тем, что развитие экономики СССР определяется народнохозяйственным планом, причем планы составляются на длительные периоды, большое значение приобретает перспективное исчисление численности и состава населения, т.е. определение будущей численности и возрастно-полового состава городского и сельского населения по СССР в целом, по союзным республикам и экономическим районам. Последнее перспективное исчисление охватило период с 1961 г.по 1980 г.

При перспективном исчислении населения прежде всего учитываются изменения в возрастной структуре населения по мере перехода одного возраста в другой. В связи с этим исчисление перспективной части населения по всем возрастам, кроме детей до 1 года, производится по методу передвижки возрастов с помощью коэффициентов дожития, показывающих сколько из живущих в каждом данном возрасте доживет через год до следующего возраста. Это означает, что технически весь расчёт населения от года и старше сводится к умножению численности однолетних возрастов на соответствующий для каждого возраста коэффициент дожития. В коэффициентах дожития для каждого возраста заложен неизменный уровень смертности на весь перспективный период, равный исходному уровню смертности.

Расчет ожидаемых чисел родившихся на предстоящие годы основан на специальных коэффициентах рождаемости /плодовитости/, показывающих среднее число родившихся на 1000 женщин определенного возраста / в пределах 15–49 лет/. При перспективных расчётах численности родившиеся исчисляются по каждому возрасту или по возрастным группам женщин, т.к.рождаемость и численность женщин в отдельных возрастах в пределах 15–49 лет значительно меняются. Сумма чисел родившихся у матерей 15–49 лет по годам дает предполагаемое число родившихся на каждый предстоящий год. Это число распределяется по полу в соответствии с удельным весом мальчиков и девочек среди родившихся, а затем из него исключаются умершие на первом году жизни, В результате получается численность детей в возрасте до I года.

Этот расчет на будущие годы является лишь первым этапом перспективного исчисления или "демографическим прогнозом". Для получения более точной перспективной численности населения нужно в демографический прогноз ввести поправки и уточнения на основе плановых демографических и экономических проектировок.

Прежде всего в этих расчетах необходимо учесть в какой мере понизится за рассматриваемый перспективный период смертность населения по отдельным возрастам. Необходимо учитывать возможности медицины к снижению смертности от отдельных заболеваний, а также влияние на смертность улучшения экономического положения населения / увеличение доходов, улучшение питания и жилищных условий/. В перспективных расчётах по СССР на 1961–1980 гг.предусмотрено, например, значительное снижение смертности детей в возрасте до I года / в настоящее время детская смертность в СССР составляет 32 умерших в возрасте до I года на 1000 родившихся.

Вторым важнейшим вопросом расчёта является правильное определение уровня рождаемости. Здесь должны быть учтены факторы, действующие на рождаемость как в сторону повышения, так и в сторону снижения. Планируемое значительное улучшение благосостояния и жилищных условий, а также улучшение соотношения между численностью мужчин и женщин будет способствовать увеличению рождаемости. В то же время дальнейшее развитие промышленности и связанных с нею отраслей будет сопровождаться значительным ростом численности городского населения за счет сельского, среди которого будут значительные резервы рабочей силы в связи с планируемым ростом производительности труда на базе его механизации; рост численности городского и уменьшение численности сельского населения будет означать снижение среднего уровня рождаемости, т.к. уровень рождаемости в городе ниже, чем в селе.

Учет всех причин изменения рождаемости и смертности и определение на основе их правильных уровней смертности и рождаемости является основным содержанием и основной трудностью второго этапа перспективного расчёта.

В-третьих, при этом расчёте должны быть учтены планируемые изменения в размещении производительных сил и размеры связанной с этим миграции населения из села в город.

Второй этап расчётов предполагает обязательное участие в нем наряду с демографами, экономистов-плановиков и специалистов медицины.

Расчет перспективной численности населения является важнейшей частью перспективного планирования, поскольку основной целью планирования является удовлетворение потребностей населения. Оценка

численности населения по городу и селу с выделением каждой возрастной группы и пола дает исключительно ценные данные для планирования развития экономики и культуры:

а/ Данные о численности населения в трудоспособном возрасте / мужчины 16-59 и женщины 16-54/ позволяют знать изменение трудовых ресурсов и их распределение по территории; эти данные характеризуют источники пополнения рабочей силы в перспективных плановых балансах трудовых ресурсов, на основе которых решаются вопросы дальнейшего развития и размещения производительных сил;

б/ данные о половой и возрастной структуре населения по городу и селу используются в планировании целого ряда показателей различных отраслей - жилищного и коммунального строительства, здравоохранения, производства товаров широкого потребления /расчет детского ассортимента для девочек и мальчиков, подросткового ассортимента, товаров для взрослых/ и т.д.;

в/ изменение численности детей и подростков является основой для планирования развития сети детских лечебных учреждений, детских яслей и садов, общеобразовательных школ и училищ профессионального образования, подготовки медицинского персонала для обслуживания детей, воспитателей, учителей и преподавателей;

Перспективные данные о половой и возрастной структуре населения широко используются научными организациями при разработке научных проблем экономического и социального развития.

10. В некоторых странах данные о естественном движении и миграции населения пытаются получить на основе выборочных наблюдений за краткие периоды времени. В связи с этим следует сказать, что в разных районах, социальных группах и категориях населения / например, среди городского и сельского, постоянного и временного/ показатели естественного движения и миграции населения настолько различны и так значительно изменяются, в зависимости от экономических и политических событий, что выборочные данные могут дать неправильную картину и приведут к ошибочным выводам. Опыт национальных республик Советского Союза показывает, что только хорошо поставленное сплошное наблюдение дает надежные данные о движении населения. Поэтому в каждой стране целесообразно немедленно ставить первоочередной задачей, наряду с проведением переписей населения, организацию сплошной регистрации рождений, смертей, браков, разводов и миграции населения.

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MANPOWER PROJECTIONS AND TECHNIQUES

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

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MANPOWER PROJECTIONS AND TECHNIQUES

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1. The development of national economic goals must take into account the future availability of manpower in adequate amounts and possessing required skills and education.

2. Dynamic changes in the United States economy have made it essential to develop techniques to anticipate future needs for workers, especially highly trained professional, technical scientific and skilled workers, with the aim of avoiding shortages that will hamper economic growth on the one hand, and structural unemployment on the other. Many of the problems associated with manpower policies in the United States are shared in common with other nations--both those already technologically advanced as well as the less developed ones. It is the purpose of this paper to describe some of the techniques utilized in the preparation of projections of manpower requirements and resources in the United States and to discuss briefly their application to developing nations.

3. The starting point for projecting manpower requirements is to project a model of the economy relating the total output of the economy at given levels, and the output of individual sectors, to levels of employment. Customarily this has involved two methods.

4. The first assumes that a given level of output will be achieved in a target period, represented by a desired level of income and consumption, or resulting from an assumed growth rate of the economy.

5. The second method--and most commonly used in the United States--is to examine the implications for manpower demand and the economy's resources by assuming they are fully utilized in the target period. This begins with a projection of the supply of labor, based on an evaluation of population trends (since the number of persons available for work depends largely on the population of working age at any given time). Data relating to population projections include figures on age and sex characteristics, and information on births, deaths, and in-and-out migration.

6. Estimates of labor force supply are accordingly derived by evaluating trends in the proportion of the population participating in the labor market. Where data for current and past periods are available, projections are made by detailed age-sex characteristics because of substantial differences among groups in their participation in the labor force. Sharp changes in labor force participation should be anticipated in an economy undergoing the transition from an agrarian to an industrial nation. Estimates of total employment are derived, based on assumed levels of frictional unemployment, work time and productivity changes.

7. Given estimates of aggregate output and employment, the next procedure is to provide detailed projections of industrial and occupational employment. Whereas estimates of labor force are significantly related to demographic variables (which are less likely to shift drastically in short periods), labor requirements are generally harder to estimate because of complex relations existing between the overall level of economic activity and the requirements of the subordinate components which dictate the number and kinds of jobs necessary to produce the total of goods and services. Among the factors affecting the need for labor in specific industries are the amount of domestic production of individual goods and services, changes in output per man-year in each industry, etc.

8. Because it is not practical to take into account explicit recognition of all the specific factors involved, analysts in the United States have sought simpler procedures for most segments. In general three types of approaches, based on past data and relationships, have beem employed in relating estimates of total economic activity to individual industries.

(a) One approach is based on the assumption that the change in employment of individual industries varies characteristically with movements in total employment; hence individual industry employment is derived from projected total employment. Employment in industries whose levels are determined in large measure independently of levels of national employment--such as agriculture and government--are projected separately. This method is useful in the first approximation and has the advantage of simplicity. However, it requires data for many previous years, is a mechanistic approach whose validity becomes weak in long-range projections, and its determinations could be misleading if new factors involving technological change and shifts in demand are not taken into consideration.

(b) A second approach is based on the relation between the production of individual industries with total projected production, which estimates are subsequently translated into employment estimates. This method, while still essentially mechanistic, provides greater opportunity for checking internal consistency, so that if original calculations appear to give distorted results, corrections can be made before the translation of products to employment is made. In this translation, changes in productivity and average hours worked must also be considered. These statistical data are more demanding, however, requiring information not only on employment but also on production, price changes, and hours of work by appropriate industry classification.

(c) The most complex and sophisticated method is to allocate total production among the various industries by use of interindustry coefficients. This requires economic and technical data covering the entire economy in a comprehensive and exceedingly detailed manner. This procedure, while requiring data on intermediate as well as final demand, permits the examination of the effects of varying assumptions on future trends in the economy. Development of an interindustry matrix requires vast processing of detailed production and shipments data.

9. A useful tool of analysis in projecting employment by occupation has been the occupational industry matrix. It presents information for some 150 industries comprising the total economy by the absolute and relative distribution of employment in about 150 occupations. Because this tool is static in nature, consideration must be given to changes in the future occupational composition, taking into account shifts in productivity and job functions related to changing technology. Use of the matrix is exemplified in a recent Labor Department study, "The Long-Range Demand for

Scientifi′ and Technical Personnel," in which a major effort was made to examine the relationships of scientific and technical employment with other economic indicators capable of being used for projection purposes.

10. After occupational requirements have been determined, estimates of the occupational supply side are made, based on a determination of the current supply of workers by occupation. Estimates must then be prepared on the additions to and withdrawals from each occupational group. In addition, other factors such as the transferability of skills among occupations, and changing labor force participation rates must be considered. Transferability, for example, is easily accomplished among relatively unskilled occupations, but even at higher levels including the professional, there is some shifting among fields of discipline. An efficient device for measuring withdrawals from an occupation are the tables of working life developed by the U. S. Bureau of Labor Statistics.

11. In the United States, the basic source of occupational data is the Census of Population; current data for broad occupational groups is provided by the Labor Department's Monthly Report on the Labor Force, based on a monthly sample survey. Estimates of occupations requiring formal training are often available from educational institutions, training facilities or licensing authorities. For other groups, unfortunately, even imprecise data are generally not available. It is anticipated that research programs undertaken by the Office of Manpower, Automation and Training of the United States Department of Labor will develop data on numbers of persons obtaining training from various sources.

12. Although differences in the political and economic framework do not permit the exact duplication of American techniques in developing economies, there are useful elements applicable with differing degrees of emphasis. In an established industrial economy it is feasible to project manpower requirements by extrapolating past trends, assuming an orderly continuation of the process of economic development. Because previous growth in a developing economy is not acceptable as a standard for future development, manpower projections in practice are related to the magnitude and nature of the economic goals established beforehand.

13. In many cases, data from other countries can be more useful than data for the subject country, for example, by developing occupational requirements for projected industry levels where the industry does not yet exist in its projected form. Or, it can be assumed that the occupational distribution at the projected level may be similar to that in some more developed country at the current or some previous stage.

14. The Puerto Rican example has direct bearing on this adaptive procedure. In the 1957 projection of Puerto Rico's manpower needs for the year 1975, it was assumed, on the basis of a projection of previous trends, that the productivity and occupational mix of most sectors would be the same in Puerto Rico in 1975 as on the United States mainland in 1950. This provided a framework for determining the number and kinds of specific skills needed to achieve the industry pattern projected for 1975.

15. The value of the projections is that work can then proceed on the development of manpower needs through programs of education and training. Where shifts in technological processes are encountered--and they should be anticipated--a system of retraining and upgrading must be provided for. Even though modifications during the period of economic development will be required, manpower projections serve as a standard for measuring performance and as a guide for action.

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SUR L'APPLICATION DE LA SCIENCE ET DE LA TECHNIQUE
DANS L'INTÉRÊT DES RÉGIONS PEU DÉVELOPPÉES

Point de l'ordre du jour : B.5

France

AMELIORATION DES CONDITIONS DE TRAVAIL ET PREVENTION DES ACCIDENTS DANS LE DOMAINE ELECTRIQUE DANS LES PAYS EN VOIE D'EXPANSION RAPIDE

Par Jean BESSOU,
Contrôleur général
à l'Electricité de France

Les mémoires rédigés à l'intention de la Conférence des Nations Unies sur l'application de la science et de la technique dans l'intérêt des régions peu développées sont des documents de travail. Ils sont publiés tels qu'ils ont été présentés et les assertions et opinions qu'ils contiennent sont celles de leurs auteurs.

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AMELIORATION des CONDITIONS de TRAVAIL et PREVENTION des ACCIDENTS dans le DOMAINE ELECTRIQUE dans les PAYS en VOIE d'EXPANSION RAPIDE

par Jean BESSOU, Contrôleur Général
à l'ELECTRICITE de FRANCE

A - INTRODUCTION

L'électrification des pays neufs est le facteur primordial de leur essor économique et conditionne le relèvement du niveau de vie de la population. Dans tous ces pays, la progression rapide de l'électrification pose des problèmes de préparation des usagers, de formation de la main d'oeuvre, pour parer au risque d'un nombre aberrant d'accidents.

Par ailleurs, la pénétration de l'électricité dans toutes les branches de l'industrie et de l'agriculture fait de l'industrie électrique une branche-pilote de l'économie nationale. Ce qui sera fait dans ce domaine pour l'amélioration des conditions de travail se répercutera dans de multiples autres domaines pour le bien de tous.

La prévention des accidents électriques apparaît ainsi comme une nécessité fondamentale; elle doit se développer en même temps dans trois directions :

- conception et réalisation des installations électriques,
- formation technique du personnel, ergonomie et conditions de travail,
- information des usagers.

B - Les DONNEES de BASE pour la PREVENTION

B.1 - La nature des risques

Dans les pays chauds, comme la plupart des pays d'Afrique et d'Amérique du Sud, la température et l'humidité de l'air augmentent la sudation et aggravent le risque d'électrocution, favorisant en basse tension la fibrillation cardiaque. Pendant les périodes sèches, la résistance des circuits de terre est élevée, ce qui diminue ou annule l'efficacité des protections classiques; dans les régions tropicales la vitrification des terres est fréquente.

Dans la conception des installations et du matériel, il faut tenir compte de ces facteurs et des conditions de vie de la population, ainsi que des habitudes de travail.

Pour le personnel d'intervention, le manque de formation professionnelle et l'analphabétisme conduisent à planifier les opérations

et à baser la technologie sur des gestes répétitifs.

B.2 - La conception et la réalisation des installations

A - Les ouvrages de production

L'option la meilleure se trouvera dans un matériel perfectionné dans la simplicité, assez près des caractéristiques classiques déjà éprouvées, en rejetant l'inédit.

L'introduction dans les postes de nouveaux matériels exigera des constructeurs l'adaptation à ces conditions particulières d'emploi et la livraison en même temps de modèles réduits animés et de maquettes avec vues en coupe montrant le fonctionnement et les points dangereux.

On notera aussi l'intérêt des couleurs de sécurité normalisées (rouge, jaune orangé et vert), dont l'effet visuel crée des reflexes de protection, surtout avec une main d'oeuvre peu évoluée. Les points singuliers des installations, correspondant à l'application des mesures fondamentales de sécurité, seront également signalés.

b - Les installations d'utilisation

Des normes particulières paraissent nécessaires pour tenir compte des conditions climatiques de fonctionnement du matériel. L'isolation des bornes et la tropicalisation seraient spécialement étudiées pour choisir, dans la gamme actuelle des chlorures polymérisés, les isolants les mieux appropriés. En raison de la modicité des ressources des utilisateurs, on s'orientera vers des solutions simples et économiques, plutôt que vers des perfectionnements coûteux.

L'emploi de la très basse tension sera préféré aux appareils d'utilisation spéciaux dits à double isolement ou à isolement renforcé. Ces très basses tensions restent particulièrement intéressantes dans les utilisations agricoles.

Les chantiers extérieurs très importants dans les pays neufs doivent être organisés en fonction des risques de contacts et comporter des circuits de terre contrôlés et connectés systématiquement aux appareils mobiles.

B.3 - Ergonomie et organisation du travail

L'ergonomie trouvera ici un terrain inhabituel mais du plus haut intérêt, où techniciens et médecins du travail auront à conjuguer leurs travaux. La main d'oeuvre locale n'est pas toujours placée dans les conditions normales, d'habitat, de nourriture et d'équipement. L'étude des postes de travail doit tenir compte de ces éléments et elle exige une adaptation des règles habituelles de physiologie du travail (horaires, appréciation des efforts, constitution des équipes, etc ...). C'est surtout pour le personnel d'intervention sur les réseaux que se présentent les difficultés, en particulier pour le travail sous tension rendu inévitable du fait de la consistance des réseaux.

C - Le PROBLEME de la MAIN d'OEUVRE et de son INITIATION aux MESURES de PREVENTION

C.1 - Les ressources en main d'oeuvre

Dans les pays faiblement électrifiés, le personnel autochtone qualifié est en très petit nombre. Il va devenir très vite insuffisant devant le développement des installations nouvelles qui, elles-mêmes, deviendront plus complexes. Un problème immédiat se trouve donc posé pour former dans le pays même une main d'oeuvre qualifiée, tant sur le plan de la Maîtrise que sur le plan du personnel d'exécution.

Ce qui est vrai pour le personnel d'exploitation des ouvrages électriques, l'est autant pour le personnel électricien des usines ou des divers chantiers de l'industrie et, d'une manière générale, pour toute la profession des électriciens réalisant les installations domestiques et agricoles.

De la compétence de ces électriciens dépend, pour une large part, la sécurité des utilisateurs et même la sécurité des installations, en particulier vis-à-vis du risque d'incendie. C'est vers des conceptions simples d'installations et des réalisations économiques que la formation technologique sera orientée.

Ainsi apparaît la nécessité d'une formation professionnelle s'étendant à toutes les disciplines de l'industrie électrique. Et en raison même du risque d'accident qui s'y rattache, la prévention devra s'intégrer dans cette formation sous toutes ses formes, ainsi que la pratique des premiers secours aux électrocutés. L'apprentissage généralisé du secourisme dans cette profession est indispensable, car les chances de succès de réanimation d'un électrocuté dépendent surtout de la rapidité d'intervention : pour ces soins on ne peut espérer avoir le concours immédiat d'un médecin; c'est donc sur les électriciens en général que repose le sauvetage.

C.2 - Les données pour une formation technique devant accroître la sécurité

a - Personnel d'exécution

Pour le personnel d'exécution, appelé à intervenir sur les installations électriques, la sécurité doit s'intégrer dans les programmes d'enseignement théorique et pratique. Cependant, les mesures de sécurité répétitives, c'est-à-dire les mesures de protection de base, pourront faire l'objet d'un enseignement spécial traduit en exercices pratiques. Le problème dos adultes analphabètes et de leur adaptation aux disciplines de l'entreprise électrique requiert une pédagogie spéciale et un choix judicieux de gestes répétitifs. Il s'agit, en fait, de traduire en reflexes conditionnés un nombre minimum de gestes de protection.

b - Personnel de Maîtrise

Il devra acquérir, comme pour le personnel d'exécution, une connaissance de la technologie du métier intégrant la sécurité, mais aussi un complément de formation spécialisé dans la sécurité en raison de ses responsabilités. Parmi ce personnel, il sera intéressant de

faire une sélection pour spécialiser les plus avertis d'entr'eux, et en faire des "Moniteurs de Sécurité". Ceux-ci peuvent avoir par la suite dans leurs équipes, outre leurs responsabilités professionnelles, un rôle de guide permanent dans la prévention et veiller au maintien de la sécurité. Ils pourront, en outre, au cours d'exercices périodiques, assurer le perfectionnement et le recyclage du personnel d'exécution, puis effectuer le contrôle du matériel de sécurité et, enfin, participer à la protection incendie.

c - Ingénieurs et Cadres

L'Ingénieur de Sécurité, dont le rôle devient chaque jour plus important dans notre économie moderne, est le conseiller permanent de la Direction et l'animateur de la prévention dans l'entreprise. Sa spécialisation implique un complément de formation portant sur les matières suivantes :

- Physiologie industrielle et physiologie du travail,
- Règlementation de l'électricité,
- Ergonomie et organisation rationnelle du travail,
- Protection contre les radiations et l'incendie,
- Notions d'électropathologie et premiers secours.

D - PLAN d'AMELIORATION et CONCOURS de la FRANCE

D.1 - L'action psychologique

L'idée dominante est d'éviter tout complexe de peur et d'obsession morbide de l'électricité, aussi bien parmi les utilisateurs que parmi le personnel d'intervention. Seuls les accès d'ouvrages ou les proximités dangereuses pourront comporter des images ou des slogans saisissants. Les campagnes de vulgarisation par affiches, concernant la sécurité dans le domaine électrique, tendront à montrer les précautions à prendre et les erreurs à éviter, en faisant subsister une note plaisante et concrète sur un thème donné, en évitant les évocations horrifiques qui finissent par créer un complexe de résignation à l'accident.

La première action psychologique, action à long terme, est à engager dans les écoles : écoles maternelles et divers établissements scolaires de formation générale.

L'information du grand public relève des mêmes méthodes que la publicité commerciale : affiches, tracts et plaquettes d'information. L'édition de plaquettes abondamment illustrées paraît être l'une des premières tâches à accomplir, pour en assurer une diffusion générale parmi la population déjà desservie en électricité, et surtout aux nouveaux usagers, au fur et à mesure du développement de l'électrification.

L'action psychologique auprès du personnel d'intervention met en oeuvre les moyens audio-visuels habituels.

D.2 - La formation professionnelle

Dans le domaine particulier da la sécurité, le Service Prévention et Sécurité d'Electricité de France a créé, pour l'initiation du personnel aux mesures de sécurité électrique, un ensemble de moyens qui ont été mis aussi à la disposition de différents pays : films, maquettes, moyens pédagogiques audio-visuels.

D.3 - La règlementation

La statistique, qui fournit dans les pays qui l'utilisent, la meilleure base d'un programme cohérent de prévention est signalée en raison de son intérêt futur. C'est pourquoi les modèles de déclarations d'accidents devront comporter toutes les rubriques nécessaires pour établir ces statistiques.

Pour la profession des électriciens, et en raison de l'importance et du caractère très technique des risques électriques, les consignes de sécurité font presque toujours l'objet d'un recueil distinct des manuels technologiques. Les recueils destinés au personnel d'exécution doivent être réduits aux notions élémentaires traduites en illustrations et présentées sous forme répétitives.

D.4 - Le matériel et l'outillage des électriciens

Nous distinguerons le matériel de sécurité collectif et le matériel individuel. Pour l'un, comme pour l'autre, se pose un problème de création, d'approvisionnement, de conservation et de contrôle. Pour les travaux effectués sous tension en particulier, où la sécurité reste le facteur dominant, les contrôles de ce matériel sont essentiels.

a - Matériel collectif

Il s'agit d'un matériel d'équipe, servant aux opérations complexes sur les ouvrages électriques, qui devra être adapté aux conditions locales. Ce sera le cas pour les dispositifs d'ascension de supports, les appareils de mise en court-circuit et à la terre, les différents matériels utilisés pour le travail sous tension.

b - Matériel individuel

L'outillage isolé et le matériel individuel des électriciens, à cause de la gêne qu'ils apportent, ne sont pas toujours tolérés; c'est le cas des gants, des casques, du matériel de manoeuvre. La Maîtrise aura ici un rôle important à jouer.

Dans les pays chauds et humides - pays tropicaux surtout - vient s'ajouter la difficulté d'équiment vestimentaire. Le port de vêtements couvrant tout le corps est indispensable pour les interventions sous tension en particulier; en période d'intempéries, des vêtements spéciaux sont nécessaires, réalisant à la fois un isolement électrique et thermique. Ces vêtements, comme les gants ou les chaussures de sécurité, sont à étudier en fonction des conditions locales d'emploi.

E - CONCLUSION

Depuis plus de dix ans, Electricité de France apporte son concours technique à de nombreux pays qui poursuivent leur équipement. Cette collaboration s'est étendue à toutes les disciplines, et le Service Prévention et Sécurité, comme les autres Services EdF, reste en liaison permanente avec les techniciens de ces pays.

Nombre de mesures décrites dans le présent exposé ont été adoptées par eux et ont donné d'heureux résultats. Le Centre d'Etudes de Sécurité de Nanterre reçoit chaque année un nombre croissant de visiteurs et de stagiaires étrangers. La documentation du Service Prévention et Sécurité est largement diffusée dans ces pays.

C'est dire que notre Etablissement est disposé à étendre son action en s'associant, sans réserve, à tous les efforts collectifs qui seront engagés sur le plan international dans le domaine de la prévention des accidents électriques.

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**CONFÉRENCE DES NATIONS UNIES
SUR L'APPLICATION DE LA SCIENCE ET DE LA TECHNIQUE
DANS L'INTÉRÊT DES RÉGIONS PEU DÉVELOPPÉES**

Point de l'ordre du jour :B. 5

France

APPLICATION DE L'ERGONOMIE AUX PAYS EN VOIE DE DEVELOPPEMENT

Par J. SCHERRER

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des Arts et Métiers, Paris

Les mémoires rédigés à l'intention de la Conférence des Nations Unies sur l'application de la science et de la technique dans l'intérêt des régions peu développées sont des documents de travail. Ils sont publiés tels qu'ils ont été présentés et les assertions et opinions qu'ils contiennent sont celles de leurs auteurs.

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APPLICATION DE L'ERGONOMIE AUX PAYS EN VOIE DE DEVELOPPEMENT

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L'ergonomie, habituellement conçue en tant que synthèse de l'ensemble des connaissances nécessaires pour permettre une meilleure adaptation du travail à l'Homme, s'est considérablement développée dans les pays industrialisés et en particulier en Europe et en Amérique du Nord, au cours de ces vingt dernières années.

Désormais, on s'oriente donc vers une modification du travail et des conditions de travail en tenant compte de ce que nous enseigne les sciences physiologiques et psychologiques. Une telle orientation est bénéfique , cela va sans dire, non seulement pour l'individu, mais également pour la productivité. Des enseignements d'ergonomie comportant différents niveaux ont été développés dans les pays hautement industrialisés. Les recherches dans ce domaine et leurs applications , en particulier au monde industriel sont nombreuses.

Nos connaissances ergonomiques peuvent et doivent également profiter aux pays en voie de développement. Néanmoins, la transposition de ces connaissances aux pays en cours dd développement , ne peut s'effectuer

qu'en tenant de quatre données fondamentales caractéristiques de ces pays , c'est-à-dire : de leur climat ,
de la formation technique des travailleurs ,
des possibilités et des habitudes nutritionnelles,
et enfin, des moyens de productions économiques.

Les climats des pays en cours de développement sont habituellement des climats chauds. Cette ambiance thermique ne manque pas de peser aussi bien à l'Homme au travail qu'en dehors de celui-ci, des problèmes particuliers . Quelques pays en cours de développement se trouvent situés dans des régions arctiques ou para-arctiques , ou encore à une altitude relativement élevée.

Le problème de la nutrition est également important dans les pays en cours de développement. Elle peut être actuellement insuffisante , mal équilibrée , mal répartie , compte-tenu de l'activité demandée à l'individu.

La formation technique du travailleur reste souvent rudimentaire , et dans un assez grand nombre de cas, l'habitude d'un travail en groupe , à l'intérieur de cette collectivité qu'est l'usine, n'a pas été acquise.

Enfin , et ceci découle de l'assertion précédente , les moyens et habitudes de production des pays en cours de développement sont à l'heure actuelle très différents de ceux des pays industrialisés , puisqu'aussi bien l'agriculture que l'industrie se placent sur le plan artisanal.

Le recours à la discipline ergonomique dans les pays en voie de développement doit tenir compte des quatre facteurs qui viennent d'être précisés.

En schématisant beaucoup, on peut distinguer ici deux ordres de fait. L'ergonomie pourrait s'appliquer à de grands ensembles industriels implantés ou devant être implantés dans les pays en voie de développement ; elle pourrait aussi se greffer , pour ainsi dire, sur les moyens de productions actuellement dominants dans ces pays.

Dans l'ergonomie des grands ensembles industriels , il est nécessaire de tenir compte très largement des facteurs humains qui ont été soulignés ci-dessus , afin de permettre simultanément une adaptation technique , physiologique et psychologique des individus à l'usine où ils vont travailler. Lorsqu'on évoque les problèmes qu'a soulevé l'industrialisation de l'Europe

au XIX ème siècle, on ne peut que souligner les précautions avec lesquelles les grands ensembles industriels doivent être implantés dans les pays en cours de développement. Il n'est nullement question de retarder de telles implantations , mais simplement d'attirer l'attention sur le travail préparatoire qu'elles nécessitent , travail dans lequel il doit être largement fait appel à nos connaissances physiologiques et psychologiques.

L'application de l'ergonomie aux moyens habituels de production des pays en cours de développement doit prendre différentes formes. Ainsi, dans un très grand nombre de cas on peut améliorer les postes de travail , grâce à ce que nous savons aujourd'hui de la physiologie des postures et des mouvements de l'individu : ceci permet de réduire les dépenses énergétiques ; dès lors , l'organisme assure mieux sa therme-régulation. Cette lutte contre la chaleur peut également être facilitée même à l'échelon artisanal , par une amélioration de l'ambiance de travail. De même les rythmes de travail que pratiquent les individus doivent tenir compte d'un certain nombre d'acquisitions récentes obtenues dans ce domaine. Lié à un problème de rythme de travail , se trouve celui de la nutrition: il faut l'adapter au mieux , compte-tenu des possibilités économiques , aux efforts exigés. Enfin , et c'est là une des préoccupations majeures de l'ergonomie , il est nécessaire d'adapter les outils , et de façon plus générale les produits du travail , aux besoins de ceux qui auront à les utiliser.

L'application de l'ergonomie au cadre des moyens de production actuellement prédominants dans les pays sous-développés s'éloigne des modalités utilisées dans les pays industrialisés. C'est là , néanmoins , que doit porter l'effort principal puisqu'il améliorera la condition du plus grand nombre d'individus et puisque quelques conseils et directives peuvent suffire pour transformer ,dans un nombre élevé de cas et de manière très nette , le rendement du travail.

Les modalités qui doivent permettre l'application de l'ergonomie dans les pays en cours de développement comportent deux étapes successives mais rapprochées.

Dans une première étape , il y aurait lieu de s'attacher , à partir

des données actuellement utilisées dans les pays industrialisés et compte-tenu des facteurs de transposition décrits ci-dessus, à la solution et à l'élaboration des éléments d'ergonomie applicables aux pays en cours de développement.

Dans une deuxième phase , on procèderait à la formation d'un certain nombre d'ergonomistes qui appliqueraient les données ainsi élaborées , tout en restant en relation étroite avec le mouvement ergonomique des pays hautement industrialisés. Ils préciseraient les données initialement établies en fonction des constatations faites sur place et de l'évolution socio-économique des divers pays.

En tout état de cause , l'intervention de l'ergonomie devrait avoir lieu lors de l'étape de planification économique et technique des pays en cours de développement. Les projets d'ensemble du développement d'un pays s'appuyeraient ainsi sur ce que la connaissance physiologique et psychologique de l'individu au travail nous apporte aujourd'hui.

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FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: G

USSR

CONCERNING THE ROLE OF FEMALE LABOUR IN THE ECONOMY OF DEVELOPING COUNTRIES OF AFRICA

By R. SMIRNOVA

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

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THE ROLE OF FEMALE LABOUR IN THE ECONOMY OF THE DEVELOPING COUNTRIES OF AFRICA

by R. SMIRNOVA

1. The problems of overcoming economic backwardness, raising the living standards of the peoples are now confronting the newly independent countries of Africa.

   One of the main aspects of economic development in Africa is the problem of ensuring a full and most efficient employment of manpower resources.

   Numerous studies carried out recently by specialized UNO organizations as well as by separate scientists made it clear that in the majority of African states a considerable part of the economically active population finds itself outside the sphere of material production, does not find employment and is doomed to hunger and poverty.

   Especially low is the percentage of African women employment. For example in Tanganyika there are only 20,777 women wage earners out of the total number of workers equalling 413,100; in Uganda - 6034 women wage earners out of the total number of workers of 225,729[1]. Women wage earners in the UAR in 1957 amounted to less than 4.3 per cent of the total number of workers in the country, in Senegal - only 6 5 per cent and so on[2].

2. The extremely uneven distribution of female labour between the branches of economy attracts wide attention. The table published by the International Labour Organization in "African Labour Survey" is very illustrative in this respect.

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1. African Labour Survey ILO Geneva, 1958, pages 355 and 667.
2. Seminar on Participation of Women in Public Life. Addis-Abab . UNO. December, 1960. Report of the UAR and Senegal representatives - participants of the seminar.

Table XVIII. Woman Wage earners in the main industries

Territory and year of reference	Agriculture	Mineral extraction	Manufacturing Industry	Building Industry	Transport	Commerce	Domestic service	Public Administration	Total
Ghana (1954)	451	172	500	714	381	410	3,829		6,457
Kenya (1956)	57,577	92	2,726	391	281	2,843	5,482 (I)	10,123	79,511
Nigeria (1953)	922	126	807	50	149	445	142	1,387	4,079
Nyasaland (1956)	1,101	4	1,264	461	13	192	2,053 (II)	-	15,088
Nothern Rhodesia (1956)	1,672	53	205	164	16	72	3,323 (III)	-	5,545
Southern Rhodesia (1956)	29,450	642	2,292	237	27	248	12,324 (IV)	-	44,991
Tanganyika (1955)	17,776	281	475	94	-	389	629 (V)	1,133	20,777
Uganda (1956)	1,889	54	444	14	10	50	3,430	143	6,034

As the table shows female labor is mainly concentrated in agriculture, commerce and the domestic service sphere.

One must bear in mind that the official statistical data does not accurately reflect the actual situation. For instance, the number of women engaged in unproductive labour is much higher than the table shows. The seminar of African women on "Participation of Women in Public Life" organized by the UNO in 1960 [4] pointed out that 2/3 of all African women are engaged in petty retail trade. Only in Lagos according to the 1956 census 32,026 women earning their living by trade. [5] In Ghana 67 per cent of women are engaged in trade.

(I) Including 1,781 in private domestic service.

(II) Including 699 in private domestic service.

(III) Including 1,187 in private domestic service.

(IV) Including 7,994 in private domestic service.

(V) African Labour Survey ILO, Geneva, 1958, p.355.

Such a high percentage of women engaged in trade is especially characteristic of the countries of West Africa.

A high percentage of women engaged in domestic service is characteristic of the East Africa countries where the number of white settlers is rather considerable. Thus in Uganda half of all the women wage earners work as domestic servants [6]. Employment of African women in such unproductive spheres as domestic service and petty retail trade is explained first of all by the economic backwardness of African states in particular by the lack of developed industry. It is necessary to add that a considerable number of African women have low professional skill, inadquate and more often no education at all; this deprives them of many possibilities of applying their energy and abilities. For example, according to the UNO data 548 thousand pupils including 159 thousand girls are studying in primary schools of Kenya, and only 45 girls are studying in higher school [7].

Taking into account the situation which exists in subsistence economies we may say that the bulk of African women comprise unskilled women-workers, servants and housewives. These toilers carry on not only the main part of farming activities, but they bear all the burden of household duties which at (considering the low level of productive forces in these countries) is rather exhausting.

From the point of the national production the labour of this great part of the population yields extremely insignificant result, since their labour is spent not so much on production of material values of society as on satisfaction of immediate requirements of separate families.

It goes without saying that economic development in African countries will bring about definite changes in the ratio of workers engaged in material production and unproductive spheres. But the interests of rapid economy development require purposeful efforts to provide for an overall rise in labour productivity. It is clear that this rise is possible only on the basis of technical progress which is constantly connected with the improvement of professional skills, rational employment of labour resources.

A sound solution of this problem will greatly contribute to a rapid development of the productive forces of African countries, which in its turn will bring about a rise of material and cultural standards of the whole population. New societies can develop successfully only if the employment of every economically active individual is productive, if every member of the society is engaged in definite industrial, handicraft, agricultural or some other activity useful for the country by which he can industriously contribute to the production of material wealth and to the values of society.

Undoubtedly a great contribution to the cause of national economy development, the rebirth of national culture and the raising of the well-

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4 1960 Seminar on participation of women in public life, Addis-Ababa, p. 1, p. 12, UN, December, 1960.

5 Economic Bulletin for Africa. Addis-Ababa.UN, 1961, Vol. 1, N 2, p. 52.

6 Inter-African Labour Institue, Bult III, 1955.

7 Statistical Yearbook, 1959, New York, UN.

being of the peoples may be made by millions and millions of African women if they are drawn into an active participation in the building of the new society.

3. The ways and means of inclusion of women in social production are manifold. For example, a mass unionization of women occupied in a familiar production process. In particular organization of female handicraft groups, cooperative teams may be of great importance.

Considerable experience in this field has accumulated in the Soviet Union and mainly in the republics of central Asia-former colonies and economically backward regions of tzarist Russia. The work of the Soviet government in liberating women from the fetters imposed on them by an absence of rights was very complicated and required great selflessness and effort. Many forms and methods of work aimed at stimulating women's participation in labour activities and raising the productivity of their labour were used. With this purpose special centres to train women in new professions were organized. For example, training centres of women cattle-breeders where women acquired new knowledge and experience in cattle-breeding and farming were of great use. Dairy farms equipped with separators and churns were organized at such centres. At the farms newly arrived peasant-women studied under the guidance of an agronomist. At that time a separator represented "modern technology" in butter and milk production and their inculcation in kishlaks was a great event.

Peasant-women organized so-called conradship associations, collectively bought separators and together produced dairy products. Sewing and fancy-work groups, women and children dispensaries were organized.

In the Turkmen SSR women united in handicraft groups producing famous Turkmen carpets. These groups concluded special contracts with state trade agencies. The Soviet state in every possible way encouraged and supported such women associations by granting credits on advantageous terms, organizing commodity markets and supplying them with raw materials.

Owing to such support the cooperation of female labor in the Central Asia Republics began to developed on a mass scale. In a number of regions women organized farms for the collective cultivation of the soil. These farms were supplied with tractors, besides they received seeds and cash to buy agricultural implements. The main benefit of these farms lay in the fact that they raised considerably the productivity of female labour and became a good basis of technical and vocational training for them.

In the Soviet Union, in the republics of Central Asia women's clubs also enjoyed great popularity. In these clubs not only work eliminating illiteracy among women was carried on, but women were trained in various professions and specialities.

Industrial sections, various workshops, groups such as sewing, weaving and others were organized at the clubs. The groups had not only training program but also fulfilled state orders according to a special plan.

The topic of this report does not make it possible to elucidate in detail all the changes in the status of women in Central Asia which took place during the years of Soviet rule. I want to stress only that the experience of the republics of Central Asia proved that it is quite possible within the life of one generation to radically change the status of women so that from a potential labour force they would become an active, motive power in the building of a new society.

4. The wide introduction of African women into productive activity is a matter for the immediate future. Since a subsistence economy prevails now in the economy of the African countries, women are confined to the family and household. But the times are moving rapidly. Life is changing quickly. The development of national economy, growth of industry will soon undoubtedly bring about a disintigration of subsistence economy. Female labour even now goes beyond the limits of a separate family and in the future will do so even more. Millions and millions of African women will directly participate in ensuring the general economic development of their countries.

With this in view the problem of improving the professional skills of working women in African countries acquires great importance. A great number of women go to work at factories directly from the household, having no industrial experience, no professional skill. Even now the experience of some African states shows that there are a number of ways to solve the problems arising in this connection.

In the first place it may be worth while to organize the systematic admission of youth to vocational schools and training groups at enterprises and to allocate simultainously a definite number of vacancies for girls. It is also possible to organize retraining of grown-up women workers through a system of evening schools and courses. An interesting example in this respect is the suggestion of the National Council of Women of Ghana concerning organization of special centres in the country on technical and vocational education of women and girls.

Ghana is one of those African countries where great attention is paid to the problems of technical education. In the past few years in the country many secondary and higher technical educational establishments engaged in a wide-scale preparation of national specialists is being built. The number of students in these educational establishments from 1950 to 1956 increased threefold and by 1957 it amounted to 3,330 students[8]. Year after year the number of girls among the students increases.

And in other African countries starting to build an independent economy the situation is similar. Guinea, Mali, the UAR already have started to realize wide-scale programs to wiping out illiteracy among adults. Compulsory primary education both for boys and girls is being introduced. It means that the next generation of African women will be educated, and there will be no illiterate women as well as no illiterate men.

In organizing a system of technical and vocational education the correct elaboration of training programs becomes of great importance. But unfortunately the training of women and girls is organized often around occupations traditional for them : cookery, needlework, sewing, housekeeping. The knowledge of these things is undoubtedly useful and necessary. But with only this knowledge it is impossible to solve that serious problem of creating new African cadres, which faces now the young independent African states. But only trained cadres can actively participate in the process of national construction.

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8 Secondary Technical and Vocational Education in Underdeveloped Countries. UNESCO. Educational Studies and documents N 3, 1959, p. 22.

5. The experience of African countries shows that the work on attracting women into productive activities is of great importance. Now when a radical reorganization of the economy as a whole is on the agenda of the African peoples, an efficient employment of the female labour force in the building of a new life becomes a matter of state importance.

The problem of raising the productivity of labour is closely connected not only with increasing the number of working women and improving their professional skill but also with the betterment of living conditions of women workers. It is important to create such conditions under which the self-sufficient individual economy unit becomes gradually substituted by more economic and labour-saving collective economy ones which employ female labour expediently. Therefore it is important that, in the organization of labour those works which must accompany production improvment and reorganing at the mode of life in order to preserve man-power and eliminate the useless and unproductive waste of labour mustbe taken into account. The way to solve this problem lies in the organization of a modern system of community service and well-being.

The attraction of women into social production will be successful only where the state considers it its duty to take upon itself the care not only of the woman-toiler but also of woman-mother.

This concern lies in the fact that the state would not only concern itself with maternity and legal protection of the child but would assume material responsibility for the interests of the mother and child by granting paid maternity leaves, organizing labour protection in undertakings, building various children's institutions and so on.

A part of the above is being put into practise already. National construction in the independent African countries has already attained considerable successes and exerted influence upon all spheres of public life. It exerts serious influence upon the exchange of views as regards the role and importance of female labour in the economy of the developing African countries. Now it is to the highest degree helpful to take into account the experience aquired during these years, to understand the forms which the work of bringing women into social production is taking, in order to find new more perfect ways of solving this problem.

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AN INTRODUCTION TO ERGONOMICS

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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AN INTRODUCTION TO ERGONOMICS

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I INTRODUCTION

1. In prehistoric times men made their weapons and tools for themselves. Efficiency, and the fitting of the tool to the operator, were vital. If a man made a bad weapon and could not use it well enough, then there was soon one less designer of bad tools alive. The tradition of the craftsman making his own tools, or selecting carefully before buying until he finds those which "feel right" (that is, which fit him well), has lasted through the ages and still applies to hand tools. But few operators can try out, and throw aside if not suitable, the bigger machines of today - such as lathes, cranes or power presses - until they find one which fits them! Still less is this possible with the more complex machines of tomorrow, such as computers, automation units and supersonic airliners.

2. Therefore in our factories and homes, in the air and on the roads, we are using machines designed by others with little advice from us about how they should be made to fit our own peculiarities. This does not mean that the machines will necessarily be badly designed or that we shall not be able to use them. But it may mean that we cannot use them as well as the designer could himself, because what fits him may not fit us.

3. In the newly developing nations this problem is accentuated by the fact that the designer may well have belonged to a totally different industrial culture on the other side of the world. Moreover, design engineers are mostly, and quite rightly, concerned to improve the mechanical and electrical performance of their machine, and it is sometimes forgotten that what matters most is how well the machine works in conjunction with the operator who has to use it day after day in his routine work.

4. Now, there is nothing especially novel about emphasizing this need for a good fit between man and machine; but the difference with Ergonomics is that it emphasizes and provides the methods for a systematic scientific approach to the problem. Engineers, managers and administrators have to make the final decisions on the design, acceptance and establishment of equipment and plant, and these decisions obviously affect greatly the efficiency and welfare of the humans to be involved. Errors can be costly in both human and economic terms, but not all such errors are necessary, let alone inevitable. Research has already yielded much relevant knowledge; but in many situations the engineer or manager may still have to fall back on "rule of thumb" or guesswork. To replace such a potentially costly basis for decisions by a systematic scientific approach is a prime aim of Ergonomics. Moreover, the engineer or manager himself often can and should use the relevant research findings, provided he is competent and able to interpret them correctly; it is not essential, even though often helpful, to have the consultant advice of an Ergonomics specialist in order to adopt this scientific approach to the human factors aspect of modern technology.

What then is Ergonomics?

5. Ergonomics is defined as the study of the relation between man and the environment in which he works, particularly the application of anatomical, physiological and psychological knowledge to the problems arising therefrom. This definition, and the field of work, clearly can embrace both research and practical application, but the

precise boundaries and the various branches of the subject are by no means yet established. The four general texts so far published are by Chapanis et al. (1949), Woodson (1954), McCormick (1957) and Chapanis (1959).

6. Research is essential to increase and refine the knowledge available on the multitude of ways in which men behave, are similar to and different from engineering components, and respond to and are influenced by their task and environment. Much of what may reasonably be regarded as Ergonomics Research is still, inevitably, in the separate disciplines. But the inter-disciplinary approach is growing, despite obvious difficulties, in keeping with the fact that the anatomic, physiological, psychological, etc., reactions of a man to any given situation will be unitary, interdependent and largely inseparable components of his total behaviour pattern.

7. The essence of Ergonomics, especially as far as the present paper is concerned, is the application of this knowledge and scientific method to practical problems. In the design of equipment and environment, Ergonomics (or Human Engineering or Human Factors, broadly equivalent names used in the U.S.A.) places major emphasis upon efficiency in the operation of the equipment as measured by the speed and accuracy of the human performances. Allied with efficiency are the safety and comfort of the operator. Because the aim here is to optimize the man-machine and man-environment combinations by suitable modifying the machine and the environment, this aspect has also been termed "fitting the work to the man". Equally important, although often regarded as a separate subject from Ergonomics, are the personnel factors such as selection, training, and adaptation to environmental and working conditions. These are studied both as part of Ergonomics and as separate topics under the headings of Work Physiology and Occupational Psychology, and from this knowledge people can be helped to modify themselves, within limits, to improve the man-machine partnership; this personnel aspect has also been termed "fitting the man to the work".

How did Ergonomics develop and where is it practised?

8. What is now called Ergonomics had its beginning, on the academic side, in the requests to university scientists to study human problems in governmental ordnance factories and elsewhere during World War I. On the engineering and industrial side, the pioneer work of Taylor and Gilbreth in the field of motion and time study helped to draw attention to the value of the analysis of jobs by skilled technicians. World War II led to much greater emphasis not merely on matching men to machines by selection and training, but also, much more than previously, on the designing of equipment so that its operation was within the capacities of most normal people. This "fitting the work to the man" increased considerably the collaboration of engineers in certain fields with the biological scientists. This collaboration, beginning primarily with military problems, because it is there particularly that operators are pushed to their limits, continued after the war and led to the formation in England in 1949 of the Ergonomics Research Society. Attention has since returned to the industrial field, and the joint approach has increasingly shown its value as an ally, according to circumstances, of design engineering, work-study, industrial medicine and personnel management.

9. The field has already grown so far that it is impossible to count, for certain, the exact total of groups at work. In Great Britain there are some 15 academic research groups*, and at least four Services' sponsored units for military problems; also four private industrial companies have sections specifically devoted to ergonomics work, the largest group now being eight years old with a permanent staff of four. In Europe*, the development is similar but on the whole more scattered and a little less advanced. In the U.S.A., particularly under the impetus of military funds, development has been much more rapid. At least 130 industrial companies have organized human factors programmes with an average group staff of 10 (Kraft, 1961) and the services' sponsored units and the academic research groups are similarly more numerous. It is difficult to learn what may be happening in the U.S.S.R., but from a literature survey Ronco and

* See the Register of Research in the Human Sciences applied to Problems of Work and Directory of Relevant Research Institutions, prepared for various European countries by the European Productivity Agency of the O.E.E.C.

Sawyer (1962) conclude that "although only a few articles were found that have to do with the direct application of knowledge of man's psycho-physiological capacities to the design of machines, ... sufficient volume of pertinent material is being generated to merit systematic attention by human engineers".

Why is Ergonomics needed?

10. This question would not be asked if the subject of Ergonomics were not mainly human. Just because we are all human, we tend to think that we automatically know most of what needs to be known about man when matching up a working situation to him. But in fact the amount of specialist knowledge now available about man, even in ergonomic aspects, is such that there is probably no one man, even a specialist himself, who can learn it and know it all.

11. If a problem arises which is primarily in, say, chemistry or quality control, we quickly acknowledge if it is outside the limits of our own general knowledge and call upon the chemist or quality control specialist for his assistance. But if we have a problem to deal with involving humans, we still tend to use our own subjective opinion or go to consult the subjective opinions of other men instead of summoning a specialist, perhaps because the existence of specialists is not yet widely known.

12. Accidents, errors, poor quality and low output are the usual symptoms of a problem which amongst other things may need ergonomic attention. When a man-machine mis-match in industry today results in such symptoms, the cost of not finding a cure is often considerable but may not be so high as to compel action. But as man in the future is progressively used less for his muscle power and more and more for his ability to process information and make decisions, so he is in control of more assets and more output, and the cost of the mis-match grows in proportion. As with military problems in the past particularly, so now with modern industrial equipment the demand upon the operator grows as the complexity increases. The more the operator is stressed the greater the need to ensure a good match between man and machine to minimise the risk of error and maximise accuracy and output. This is the fundamental reason why the specialist's knowledge from Ergonomics is needed as a supplement to modern technology.

II RESEARCH

13. The wide range of Ergonomics research relevant to practical problems is best shown by references to examples drawn from the main biological sciences from which knowledge is applied. There is only space to mention a small fraction of the huge field.

14. Functional anatomy is concerned with the body framework, posture, and the use of muscles; it can, therefore, provide knowledge of the best ways in which force can be applied or objects lifted and also about the limits of joint movement. This knowledge is, of course, very important in the design of controls such as levers and foot pedals. For example, the activity of muscles during typewriting has been studied by Lundervold (1958), the strength of a man's lifting action by Whitney (1958), and a typical case-study of a practical situation (railway engine driving) in which the limb position and force required, amongst other things, were a serious impediment has been reported by Schwab (1958).

15. Anthropometry yields data on body sizes and dimensions, both for male and female, and thus can help with the optimum design of the height and size of working surfaces, the position of hand and foot controls, the shape and height of seating, and so on. For example, the usual height of a chair is 18 inches, which has been shown by Floyd and Roberts (1958) to be too high for about 70% of the male population and 60% of the female population (if wearing $1\frac{3}{4}$ inch heels). This same research by Floyd and Roberts (1958) has been the basis of a British Standard (BS 3079) which is at last bringing better dimensions to office desks and chairs in Great Britain.

16. Work physiology covers the whole field of bodily activity, particularly with reference to many different types of environment. For instance, reasonable measurements for physical work can be made in terms of calorie consumption, and on the practical side, from this knowledge, it is possible to calculate the most efficient organisation of work and rest pauses, to minimise fatigue, etc. Lehmann (1958) has shown how "hidden" rest pauses may often have to be taken and how it is more efficient to organize official pauses realistically. Again, from India, Caplan (1946) has reported an experimental study of the effects of heat on workers in the Kolar gold mines, where he estimated that with a wet-bulb temperature of above 83°F. the efficiency in a normal shift of six hours would decline by about 60%; this loss, once realised, could of course be decreased if more ventilation and air conditioning could be installed.

17. Psychology covers the whole field of human behaviour, and particularly such aspects as how an operator receives and processes "information". From this one can estimate, for instance, the rate at which the operator can be given information by a system and act upon it, what delays and errors may result, and how best to design the input and output equipment leading to and from him. Conrad (1960), in describing some of his research related to post office telephonic and letter-sorting problems, illustrates well this part of applied psychology. Among practical design researches, Gibbs' (1952) machine tool indicator should be noted, together with another proof of his method by Gordon and Radhakrishnan (1959). Again, the problems of training difficult skills are particularly relevant to newly developing countries; some recent research by Bowen and Kelley (1962) has shown how there may be a generalisable skill involved in controlling such vehicles as aircraft and ships and has resulted in a technique and equipment for training this type of skill which is greatly superior to existing methods.

18. It should also be emphasized how workers in Ergonomics are aware of the future problems likely to arise from advances in technology. As long ago as 1955, Mackworth (1955) discussed the relevance of research then for the problems to be expected when automation came, and with automation still hardly arrived Welford (1960) could survey the aspects of Ergonomics likely to bear on the design of automatic equipment and the human problems likely to arise from automation.

III APPLICATION

The approach of Ergonomics to practical problems

19. The primary emphasis is upon a scientific approach, i.e. upon objective study and the gathering of reliable facts from which deduction and recommendations can be made and proved statistically to have an adequate measure of validity. Opinionative advice and solution are avoided unless specifically requested in preference to no advice at all, and only then with great emphasis upon the unproven and speculative nature of such recommendations.

20. In tackling specific problems to fulfil the general aim to produce well-integrated man-machine combinations, the ergonomic approach has six definite sections, some or all of which are implemented according to the type and complexity of task, machine or system being considered. The first three sections are relevant when the design, redesign, or at least some modification to the design of the equipment is being undertaken. The last three are relevant when some choice or modification of personnel is desirable and can be implemented. In describing and illustrating with references these sections, there is again only space enough to mention a minute proportion of the whole field.

Design of Equipment

21. The first process, more significant with major systems than with individual machines, is to describe and analyse the system as a complete unit, using operational and physical flow diagrams as appropriate, and to subdivide the whole into funtionally separate sub-tasks. Each sub-task is then considered in turn, to decide whether the use of a man or machine as the sub-unit is more appropriate; such factors as cost, weight, size, reliability, safety and efficiency must be assessed and compared for each sub-unit separately. At the same time, the selection and training problems, as conditioned by the likely availability of suitable personnel to train and be trained, must be taken into account also as factors vitally affecting the decision between man and machine for sub-task units. Finally an optimum balance must be decided on all these factors for the combination of sub-units into the complete system. The methods of system design and the application of human factors have been described and illustrated in detail by Van Cott and Altman (1956), and broadly covering the whole field of systems engineering by Flagel (1960). Christensen (1962) has described the evolution of the systems approach and has given a commentary on the growth of Ergonomics thus far which gives a good perspective to the whole, and Kidd (1962) has debated some of the problems of methodology.

22. Second, for each machine or for each part of a system where the human element is used, the interaction between the man and the equipment must be optimised. To do this, an approach is used which is slightly different from that of the engineers, who rightly must start his thinking from the machine and concentrate upon that. The ergonomic approach is to examine the task and the operational sequence that the man will have to do and to consider the man's abilities and limitations and how they will influence the total task performance. With the man as our centre, we then work outwards from him, thus coming to examine his interaction firstly with the machine or task, and next with the immediate workspace around him (the chairs, desks, machine console, etc.) and finally with the general environment in which he and the machine are to work (thus coming to such problems as heating, lighting, ventilation, etc.). To ensure an adequate study and reliable recommendations it is important to examine in detail each one of these three zones of interaction in turn (see Table). Only in this way can we be sure to take account of all possible influences upon the man and his work. This zonal approach is implicit in much of the ergonomics literature. An explicit description of its use during the design of the operator's console for a large digital computer has been given by Shackel (1962).

23. Third, even if re-designing an existing working situation, and especially if involved in the design of a completely new machine system, the proposed and agreed final design should be evaluated by mock-ups and trials to test the validity of decisions on human factor aspects, in exactly the same way that models and trials are used to check important engineering sections of any system. Such evaluation trials should particularly use samples of the expected final operators. A general purpose, computer programmed, research tool for such evaluation work during the system design stage has been reported by Johnson et al. (1961). Gruber et.al. (1961) have described in detail the methodology of a very thorough evaluation study and thus provide a useful model for this third part of the practical ergonomic approach, which completes the design procedure and should confirm finally the equipment design established.

Personnel factors

24. Fourth, assuming choice is possible, proper personnel selection procedures should be established. As with equipment design, the selection procedure should be based on a comprehensive analysis (cf. Rodger and Cavanagh, 1959), from which a job description is prepared in precise operational terms along with an outline of the qualifications and experience required and any difficulties and distastes peculiar to the work. Decisions can then be made, which should later be validated, on the conduct of interviews and on the choice of test and questionnaire material. This basic selection procedure applies

whether we are involved with establishing the manning policy and selecting the staff for a new system being installed or, as more commonly occurs, with the broader aspects of selecting the staff at various levels in a company or industry. Thorndike (1949) discusses these techniques, and practical applications are described by Vernon and Parry (1949) and Rodger (1945). Some interesting and well validated work has been done on the selection of engineering apprentices by Frisby et al. (1959) and by McMahon (1962) and his colleagues. On the difficult problem of selecting for sensorimotor skill aptitude, Bowen and Kelley (1962) appear to have developed a promising instrumental approach, which may prove particularly relevant to the problems of newly developing nations.

25. Fifth, if special knowledge or skill is required, suitable training must be established. The job requirements and methods must be studied carefully to elicit the significant cues and features upon which correct performance will depend, so that maximum attention is given to them. Also appropriate methods must be devised for providing knowledge of results as quickly as possible during training. A general discussion of the problems and suggestions on methodology have been given, for instance, by Blain (1956) and Seymour (1959), and a review of some recent studies has been published by D.S.I.R. (1960). Also, a new approach to certain types of problem has been developed by Belbin (1957, 1958) and shown to be an advance over other methods. The subject of training cannot be left without brief mention of the advent of teaching machines (cf. Lumsdaine and Glaser, 1960, Morrill, 1961, and Ryan et al., 1962), which will undoubtedly in time help to revolutionize methods and solve some of the major teaching problems, especially of the new nations. Reasonably satisfactory validations have been reported, for instance with naval subjects by Wallis (1962), but much work is still needed before unequivocal acceptance will be possible.

26. Sixth, under the heading of personnel, attention may also be devoted to a range of problems such as welfare, labour relations, acclimatisation to heat and cold (e.g. Edholm, 1954, Burton and Edholm, 1955, Pepler, 1958), absenteeism and other reactions to shift work (e.g. Shepherd and Walker, 1957), accidents and safety (e.g. Shaw, 1954, Laner and Sell, 1960). These must not be overlooked, and are all aspects studied by Ergonomics in conjunction, where appropriate, with specialists in sociology, work study, industrial hygiene, etc.

Conclusion

27. The importance of this six-pronged approach lies in three aspects. First, it ensures comprehensive gathering of all relevant data concerning the particular problem situation, and greatly minimises the risk of wasted time and inadequate solution by premature concentration on the apparent but not real cause of a problem. Secondly, this approach emphasises that working situations are dynamic, and that any attempt to solve problems in such situations must, to be successful, study the total man-machine functioning as a series of actions and interactions, as a cine film and not as a drawing or still picture. Finally, it emphasizes that man is a whole creature and reacts as a whole to his working environment. He must therefore be studied as a whole entity from all the above different viewpoints, more or less simultaneously, if a correct perspective is to result. This emphasis and co-ordination of a global approach is one of the especial contributions of Ergonomics.

IV CONCLUSIONS

Where is Ergonomics relevant in modern industry?

28. On the shop floor there are many situations where scientifically proven methods of selecting and training operators would yield worth-while economic improvement. Organisationally it would seem that these situations can best be dealt with by personnel

and work study departments making use of technical data and consultant advice from Ergonomics where relevant. In many companies it may not be good economics to employ a full-time Ergonomics specialist for this work alone.

29. When new machines and task situations are being designed or considered for installation, Ergonomics becomes more particularly relevant, and the cost of obtaining such knowledge, particularly if it is sought early enough in the design stage, becomes relatively insignificant in proportion to the typical capital cost involved and the potential savings to be expected.

30. The same arguments apply with much greater force still as complexity increases and the design of larger production units and systems is considered. A continuous-flow production line is a typical example of a modern industrial situation requiring some thorough system design. The bigger such a line is the greater is the importance of adequate feed-back and feed-forward of information from one stage to another to maintain everything within limits; but very frequently one finds that still only the most primitive means of communication are available between operators, who are now usually at much greater distances from each other. Only thorough and extensive study of what information each operator needs from the machine and each other, and of the way that the system should be designed to present this information most simply and easily, can safeguard against lengthy commissioning time and the risk of costly shut-downs. The emphasis of the ergonomic approach on dynamic rather than static investigation and planning could be very fruitful here.

What would be correct management policy?

31. Only broad generalisations are possible, because so much depends upon the nature of a company's product and organisation. The manufacturers of complex capital goods are more likely to find ergonomic help of practical and economic value than are manufacturers of simple products. On the other hand, any manufacturer contemplating major capital expenditure on new plant or new production facilities, particularly envisaging a major increase in the complexity of his manufacturing processes, might well save much trouble later by getting ergonomic assistance early enough.

32. In general, the best criterion is probably the financial size of the company compounded with the amount of man-machine conjoint working-time involved, either (a) in the consumer's use of the product or (b) on the production floor, according to which aspect of ergonomics application is being considered. For instance, (a) on the question of Ergonomics applied to the design of the company's products, manufacturers of machine tools, motor cars, furniture and household appliances have much greater need for ergonomics knowledge than manufacturers of electrical generators, tyres, submarine cables and water tanks. Again, (b) on the question of Ergonomics applied to production methods, manufacturers with a high ratio of labour to other costs, (such as in the boot and shoe industry) with special environmental problems (such as in steel or tyre making) or with important safety considerations (such as passenger transport services) can expect significant improvements in efficiency and safety by applying ergonomics knowledge.

33. Given a 'prima facie' field of application, the scale of ergonomic activity required and the manner of obtaining it will then depend on the size and turnover of the company. In general, it would seem that only large companies, say of more than one or two thousand employees, or those with a large turnover, say of more than one or two million pounds, are likely to feel justified in employing a full time specialist on their staff. Most managements would be better served by seeking consultant advice when appropriate. This, however, points to the need for one important action. When a decision has been taken to seek ergonomic advice only when required, it is essential to establish, within the normal organisation of the company, a clear definition of who is responsible for watching over the general running of the company to detect when and where ergonomic assistance would be economically desirable. Some one or more persons should

be given the necessary training and charged with the responsibility of watching for operationally significant ergonomic problems and, when they arise, with the duty of seeking the specialist advice required. In various industries and companies this function is carried out sometimes by the medical officer, sometimes by the work study department, sometimes by the production manager, and sometimes by the chief engineer or his staff.

34. Therefore, in relation to Ergonomics, a management decision is required, in a company of any size, upon the following three points:

(a) What areasof our factory and/or products might benefit from the application of ergonomic knowledge?

(b) Does our requirement justify a full time specialist or a consultant on retainer or a consultant called in as necessary?

(c) If a consultant is to be used at any time, what department or person shall be charged with the duty of watching for significant ergonomic problems and calling in a consultant in good time?

Why and how is Ergonomics relevant to newly developing countries?

35. With its emphasis on and methods for helping towards

(a) better designed equipment, to improve ease of use and minimise operator errors, and

(b) better selection and training, to improve the skill and care of any given operator with his equipment,

Ergonomics can contribute significantly towards efficiency, safety and productivity in the newly developing countries. Less risk of error and therefore less damage and less down-time are proportionally of greater value there than in, say, the U.K. or U.S.A. because capital equipment is relatively scarcer and more valuable. Thus Ergonomics can contribute towards getting the maximum effective return per unit time from invested capital.

36. To achieve this, Ergonomics would aim at equipment designed or modified to fit properly the natives of the country, at selection and training procedures (adapted to the prevailing conditions there) to inculcate adequate skill and knowledge, and at instruction books and other aids especially designed for the particular country (not just copies or translations of the original which have usually been designed for the sophisticated technicians of the manufacturers' country). Above all, when equipment is to be purchased from abroad, Ergonomics would insist on a contract condition that the equipment must be proved to meet its full specification when in the hands of a representative group of trained but otherwise ordinary users in their native terrain. Since this is the purpose for which the equipment is bought, the onus should be on the manufacturer to see that the purpose is fulfilled.

What policy might such countries adopt?

37. A teaching and research department might be established at a principal engineering college of the country (there are several models to follow, for instance Prof. J. Lyman, University of California at Los Angeles, or Dr. W.F. Floyd, College of Technology, Loughborough). This department would concentrate on teaching the engineers and administrators of the country the technical basis of Ergonomics in equipment design and in personnel selection and training (if no Department of Psychology is available to help). It would also be concerned with monitoring the use of these techniques in the country and with seeing that they are modified to suit prevailing conditions (to avoid slavish and inappropriate copying of methods used elsewhere).

38. Separately, although having some links with such a teaching unit, an operational evaluation department might be established in association with the technical evaluation group belonging to whatever national purchasing agency is in existence. The operational evaluation department would examine, advise on, and specify modifications to the machine design, instruction books, etc., for the whole range of capital equipment being considered for purchase from abroad.

39. Such a group should be given the power to negotiate modifications with the manufacturers, and would have suitable representation on the final selection committee. It would be expected to establish its advice on the basis of operational field trials. It might also organise a subdivision in charge of the introduction of new equipment when purchased; it would do this through one or more special training centres at which the manufacturer would teach the first group of native instructors, both for centre and field work, who would carry on thereafter. Alternatively, a separate department might be established to organise this important function.

40. It is likely that some countries will already have such training centres for introducing new equipment. In such cases the way to bring in the ergonomics aspects to the full would be to send a senior engineer who is enthusiastic to a one-year course in Ergonomics. On his return he would be able to develop the statistically controlled user trials of equipment proposed for purchase, and then report on the relative merits and negotiate modifications.

41. From his knowledge of the way in which some equipment is not well adapted to the conditions and users in its country of origin, (e.g. Shackel, 1959), the author is certain that there are many instances where a policy, such as that sketched above, would greatly improve the operational usage and minimise the waste and 'down-time' which are so often dismissed at present as operator error or ignorance. It is because man is so adaptable that the designer is often able to hide the shortcomings of his machine design behind the skill of the operator, who is rightly proud of that fact. But the more skill required and the less well-trained the operator, the more easily he may break down under stress and make an expensive error. This is not his fault, and the task of Ergonomics is to simplify the machine design enough and train the operator enough to remove the risk of error but leave the pride of skill.

42. In the achievement of this goal Ergonomics will make a very real contribution both to job satisfaction and to productivity in the newly growing nations.

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TABLE 1.

THE ZONAL APPROACH IN ERGONOMICS

I. MAN

Consideration of Sex, Age, Size, Physique, Intelligence, Experience, Training, Motivation

Definition of operational modes e.g. searching, tracking, monitoring, decision-making

required in final situation and thus consideration of abilities and limitations of human operator for all aspects of the task.

II. MAN-MACHINE INTERACTION

Influence, on operator and his decisions, of

Displays - sensory input to operator

Controls - motor output from operator

Panel Layouts; display-control compatibility

III. MAN-WORKSPACE INTERACTION

Influence of Machine size on position, posture and reach
Chairs, desks, etc.
Adjacent machines, structures and material etc.

IV. MAN-ENVIRONMENT INTERACTION

Influence of Physical aspects upon behaviour and performance
Chemical
Biological
Psychological

Physical - Light and colour, noise, heat, ventilation, gravity, movement, electromagnetic and nuclear radiation.

Chemical - Gas or liquid, composition, pressure, smell.

Biological - Microbes, insects, animals.

Psychological - Workteam, command structure, pay and welfare, shift conditions, discomfort or risk, socio-psychological aspects of the particular factory, neighbourhood, town and type of industry concerned.

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